RELATIONSHIP BETWEEN STUDENTS' PERCEPTION OF BIOLOGY LEARNING ENVIRONMENT AND THEIR ACHIEVEMENT, MOTIVATION AND ATTITUDE IN CO-EDUCATIONAL SECONDARY SCHOOLS, IN SIAYA COUNTY, KENYA

BY

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MASENO UNIVERSITY

DECLARATION

DECLARATION BY THE CANDIDATE

This thesis is my original work and has not been submitted for a degree in this university or any other educational institution.

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DEDICATION

This study is dedicated to my wife Sarah, my sons Evan, Marvel and Prince and my daughter Praise for their patience, understanding and support.

ABSTRACT

Constructivist Learning Environment (CLE) is generally understood to increase student learning outcomes like achievement, motivation and attitudes towards learning. However, these benefits are not yet established in relation to Biology pedagogy. In Siaya County, Biology achievement in co-educational secondary schools has been poor. For instance in 2010, 2011 and 2012 their means were 26.32%, 26.13% and 33.8% compared to the national mean at 29.23%, 29.84% and 40.17% respectively. Poor performance has been attributed to teacher-centered approaches as opposed to learner-centered approaches to teaching. The purpose of this study was to investigate the relationship between students' perception of Biology learning environment and their achievement, motivation and attitude in co-educational secondary schools in Siaya County from a constructivist perspective. Specific objectives of the study were: to examine the students' perception of Biology Learning Environment, to establish the correlation between students' perception of Biology learning environment and achievement, motivation and attitude, to determine gender differences in students' perception of Biology Learning Environment all in High achieving schools (HAS) and Low achieving schools (LAS). The study was based on Phillips et al (2010) concept of learning which conceptualizes learning as consisting of Learning environment, Process and Outcomes. A correlational survey design was used in this study. The population comprised 7900 (4450 boys and 3450 girls) Form 2 students from HAS and LAS in Siaya County. The study sample was 815(466 boys and 349 girls) Form 2 students in HAS and LAS drawn from 18 cluster schools using multi-stage cluster sampling. The instruments used in this study were: Student Perception Questionnaire (SPQ-Actual and SPQ-Preferred), Student Achievement Test (SAT), Student Motivation Questionnaire (SMQ), Student Attitude Questionnaire (SAQ) and Student Interview Guide (SIG). Chronbach alpha reliability coefficients of the instruments were established through a pilot study as 0.823, 0.855, 0.794, 0.875 and 0.784 for SPQ-actual, SPQ-preferred, SAT, SMQ and SAQ respectively. Validity was established through expert judgment. The t-tests, Pearson Correlation Analyses and Multiple Regression Analyses were used to test hypotheses. All tests of significance were computed at α=0.05. The findings indicate significant differences between: HAS and LAS in perception of Actual Learning Environment (ALE) and Preferred Learning Environment (PLE). Significant associations between: ALE and achievement in HAS and LAS, PLE and achievement in HAS and LAS; PLE and motivation in HAS and LAS; PLE and attitude in HAS. Non-significant associations between: ALE and motivation and attitude in HAS and LAS, PLE and attitude in LAS. Significant gender differences in perception of PLE and non-significant gender differences in perception of ALE. It is concluded that CLE can enhance student achievement, motivation and attitude. It is expected that the findings of this study would help teachers to create learning environments that enhance motivation, attitude and achievement in Biology.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACRONYMS

CEMASTEA	Centre for Mathematics, Science and Technology Education in Africa
KCSE	Kenya Certificate of Secondary Education
KIE	Kenya Institute of Education
KNEC	Kenya National Examinations Council
OECD	Organization for Economic Cooperation and Development
SPSS	Statistical Package for Social Sciences
UNESCO	United Nations Educational, Science and Cultural Organization

ABBREVIATIONS

ALE	Actual Learning Environment
CLE	Constructivist Learning Environment
HAS	High Achieving Schools
LAS	Low Achieving Schools
PLE	Preferred Learning Environment
ROK	Republic of Kenya
SAT	Student Achievement Test
SAQ	Student Attitude Questionnaire
SIG	Student Interview Guide
SMQ	Student Motivation Questionnaire
SPQ	Student Perception Questionnaire

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Biological knowledge has played a very significant role in the society. It has been a panacea to problems of diseases and poor yields in agriculture by production of disease resistant and high yielding plants and animals; overpopulation through the development of hormone based contraceptives (Maundu, Sambili & Muthwii, 2005; Campbell & Reece, 2002). In addition, the subject is a precursor of biotechnology, which is a tool for industrial and technological development (KIE, 2002). Biology education has received contemporary attention due to rapid progress in this domain that has raised ethical issues like therapeutic cloning and animal experimentation; environmental issues like global climate change and conservation (Usak et al, 2009). The learning environment is the place where the ability to apply biological knowledge is conceived and nurtured.

The contemporary challenge in Biology teaching is to create learning environments that involve the learners and support their own thinking, evaluation, communication and application of the scientific models to make sense of these experiences. In a constructivist learning environment, learners construct knowledge out of their experiences which are associated with pedagogical approaches that promote active learning (Akinoglu & Tandogan, 2007; Afolabi & Akinbobola, 2009; Inel & Balim, 2010). In such learning environments, the teacher's role is that of an initiator, a guide and a facilitator of the learning process (Afolabi & Akinbobola, 2010; Inel & Balim, 2010). According to Neo and Neo (2009), a constructivist learning environment play an important part in achieving meaningful and retentive learning since it allows students to improve their problem solving, creative thinking and critical thinking skills.

According to Ozkal, Tekkaya and Cakiroglu (2009), the classroom has become an important place for educational research because most learning takes place there. This psychosocial and pedagogical environment has been researched extensively in the last three decades in the developed countries with results providing consistent and convincing evidence that the quality of the classroom environment is a significant determinant and predictor of student learning (Green et al, 2004; Pekel, Demir & Yildiz, 2006), cognitive outcomes (Arisoy, Cakiroglu & Sungur, 2007; Mucherah, 2008; Fraser,2012; Tran, 2013), motivation and attitude(LaRoque, 2008;Charik & Fisher, 2008; Chionh & Fraser, 2009). The United Nations Educational, Science and Cultural Organization (UNESCO) in an assessment for improving learning environments in USA, Canada, Australia and India documented that the characteristics of learning environments that most frequently correlated positively with learning gains and outcomes were cohesiveness, satisfaction, task difficulty, formality, goal direction, democracy and material environment. The learning outcomes were found to be co-determined by other variables such as student aptitude, quality and quantity of instruction and psychosocial environment of the classroom (UNESCO, 2012). According to Walberg (2002) the factors that contribute to variance in students' cognitive outcomes are student motivation, the quality and quantity of instruction and the psychosocial environment of the classroom. This implies that to promote educational quality there is need to develop positive learning environment.

According to Webster and Fisher (2003) the learning environment can influence the behavior of students and consequently their success in the learning process. This can greatly impact on their achievement, motivation and attitude. The Organization for Economic Cooperation and Development (OECD) in a teaching and learning international survey reported that the constructivist learning environment prevailed mainly in the North Western Europe countries, Scandinavia, Australia and Korea. The direct transmission (teacher centered) classroom environments have prevailed in Turkey (Bas, 2012); Brazil, Southern Europe and Malaysia (OECD, 2009).

According to Osborne, Simon and Collins (2003), many countries are experiencing a phenomenon where the enrollment of young people in science classrooms is declining due to negative attitude towards science. In response to this phenomenon, UNESCO (2010) observed that constructivist pedagogy could be effective for procedural and conceptual learning in science education. Learning environments characterized by constructivism are likely to encourage student autonomy and enhance the relevance of scientific knowledge. At the same time it could help students to realize the link between their effort and success and also promote development of mastery goal orientation and intrinsic motivation (Muller & Louw, 2004; Sungur & Gungoren, 2009; Kember, Ho, & Hong, 2010). The implication is that there is need for the teachers to structure the learning environment in such a way that students get strategies, skills and abilities to be successful in the classroom as well as out in the ‘real’ world. This is likely to reconnect the students’ lives to school science and provide space for their ideas which are primers for new knowledge.

Many scholars have observed that learning environment research has dominated the western countries and Asia for long (Mucherah, 2008; Ozkal, Tekkaya & Cakiroglu, 2009; Otami, Ampiah, Anthony-Krueger, 2012). Mucherah (2008) has specifically noted that studies exclusively devoted to improving learning environments are still relatively rare in less developed parts of the world.

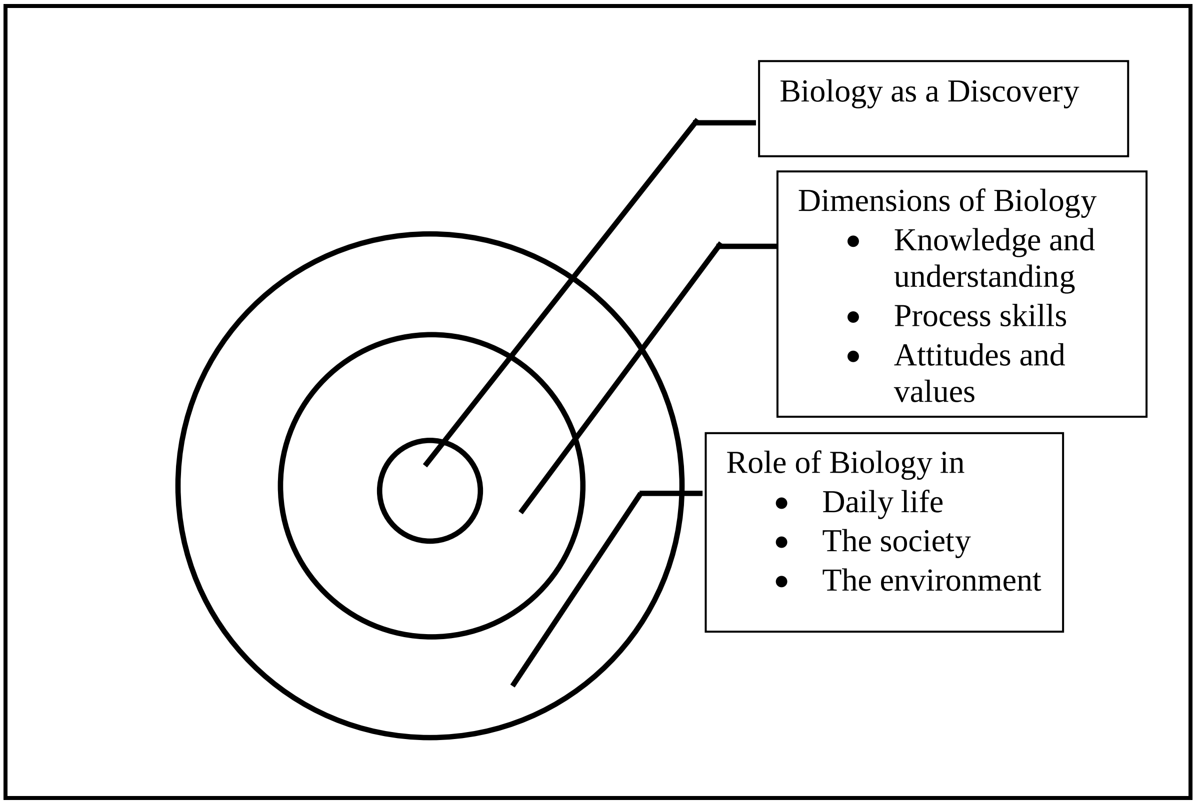
In Africa, learning environment research has been conducted in few countries like Ghana by Otami, Ampiah and Anthony-Krueger (2012) that focused on factors influencing students' perception of their Biology classroom; South Africa by Aldridge, Fraser and Laugksch (2012) that reported relationships between school-level and classroom level environment in science classrooms; and Botswana where Thenjiwe and Boitumelo (2012) compared teacher quality and student performance in Mathematics. According to UNESCO (1986) one of the problems facing Biology teaching in Africa relates to interpretation of the psychology of learning in specific classroom situations. Kinchin (2000) avers that Biology consists of many unfamiliar concepts which involve complex relations. In this state of affairs, teachers' favored approach is teacher centered approach which fails in the face of multilevel, complex interactions involved in Biology. A study carried out in Ghana by Otami, Ampiah and Anthony-Krueger (2012) revealed that the students had low perception of the Biology classroom environment. The low perception of Biology classroom environment could also be positively associated with low motivation and attitude of students towards Biology. The few studies that have been conducted have not considered the constructivist learning environment. A study in Botswana classrooms by Thenjiwe and Boitumelo (2012) revealed domination of rote learning strategies. Implicit in these arguments is that there is need to study learning environments especially from a constructivist perspective to provide data for improving the learning environment and derive the benefits therein.

The regional perspective with regard to learning environment is not any different. In a cross country study of Eritrea, Ethiopia, Rwanda and Tanzania, Bine and Woods (2008) revealed lack of co-ordinated approach to reform of teaching. They continue to observe that commitment to modernization and reform of teaching has not been translated into practice. The reality in most classrooms was the use of didactic methods characterized by little or lack of instructional materials. According to Barrow and Leu (2006), the situation particularly in Ethiopia was worse, where the teachers' perception of successful learning was rote memorization of facts. In Tanzania and Uganda there is domination of teacher centered approaches, low performance and low motivation (Earnest, 2004). This implies that the classroom situation in the region does not allow for active student involvement in the process of construction of new knowledge.

Teaching of Biology in Kenya has been predominantly teacher-centered (Orora, Wachanga & Keraro, 2005; CEMASTEA, 2011). The conventional classroom interactions have been described as predominantly transmissive. In this model of classroom environment, the learner is passive; knowledge is fixed, objective and non-problematic; the process of learning is absorbing information and the teacher is the provider of information (Okere, 1997; Kim, 2005; CEMASTEA, 2011). In this kind of situation, the perception of the classroom environment is likely to be negative and impacting on motivation and attitude towards learning and hence achievement. CEMASTEA (2011) has observed that teaching is directed at students and not organized for students. This means students are expected to accumulate a great deal of unrelated facts, skills, formulae, laws, theorems and procedures without any attempt to relate them to the students' previous knowledge and experiences. In such a situation, the acquisition of important and meaningful mathematical and scientific concepts is greatly hampered.

The current Kenyan secondary Biology curriculum outlines ten broad objectives for teaching Biology derived from the national goals (KIE, 2002). These are to:-communicate biological information in a precise, clear and logical manner; develop an understanding of interrelationships between plants and animals and between human and their environment; apply the knowledge gained to improve and maintain the health of the individual, family and community; relate and apply relevant biological knowledge and understanding to social and economic situations in rural and urban settings; observe and identify features of familiar and unfamiliar organisms, record observations and make deductions about the functions of parts of organisms; develop positive attitudes and interest towards biology and relevant practical skills; demonstrate resourcefulness, relevant technical skills and scientific thinking necessary for economic development; design and carry out experiments and projects that will enable them understand biological concepts; create awareness of the value of cooperation in solving problems; acquire a firm foundation of relevant knowledge, skills and attitudes for further education and for training in related scientific fields.

From the objectives of teaching Biology in Kenya, it appears that at the ‘heart’ of the Biology curriculum is the philosophy of discovery which is founded on three dimensions of i) knowledge and understanding, ii) science process skills and iii) values and attitudes. The curriculum is grounded on the intention to make Biology applicable in everyday life, the society and the environment. This framework is shown as figure 1.



Adapted from KIE (2002)

Figure 1: Conceptualized Biology Curriculum Framework

It is evident that the curriculum aims to enhance all students’ scientific literacy; According to American Association for the Advancement of Science (AAAS), scientific literacy should help students grasp essential science concepts, to understand the nature of science, to realize the relevance of science and technology in their lives and to willingly continue their science study in school or beyond school (AAAS, 1993). The discovery approach when implemented enhances the development of science process skills. The values and attitudes embodied in the framework according to Maundu et al (2005) aim to nurture scientific attitudes like problem solving, curiosity, manipulative ability, good practical visualization, spontaneous flexibility, initiative, interest, open-mindedness, and inquisitiveness. With the attitude of curiosity, students will value Biology as an important tool to investigate their natural world. This would transform learners from mere recipients of biological knowledge to constructors of biological knowledge. The role that teachers should play as leaders of discovery in a learning environment that encourages and challenges students to develop a sense of discovery is that of facilitation and guidance.

Despite the fact that the current Biology curriculum recommends the use of constructivist oriented approach in which students are expected to learn Biology by active involvement and discovery, this is rarely the practice in science classrooms in Kenya (Orora, Keraro & Wachanga, 2005; CEMASTEA, 2011). Okere (1997) particularly points out that learning environments in a majority of Kenyan secondary schools is characterized by the presentation of the product of science first rather than the discovery approach as recommended by KIE (KIE, 2002). In this regard, students in practical classes often follow some laid down procedure to confirm principles or laws already established. In such a situation, the noble aims of science education are not realizable. The Kenya Certificate of Secondary Education (KCSE) examination results show that most students have been performing poorly in Biology (KNEC, 2007). This trend has been of concern to many researchers in Biology education in Kenya (Wekesa, 2003; Orora, Keraro & Wachanga, 2005). Table 1 shows a comparison of national, Siaya County and co-educational secondary schools', performance in Biology between the years 2007 and 2012.

Table 1: National. County and Co-educational Schools Performance in KCSE

National Performance			Siaya County Performance		Co-educational schools performance	
Year	Mean score	Mean %	Mean score	Mean %	Mean score	Mean %
2007	83.90	41.95	4.820	40.16	3.512	29.26
2008	60.64	30.32	5.235	43.63	4.532	37.76
2009	54.29	27.20	4.012	33.42	3.712	30.92
2010	58.39	29.23	3.495	29.13	3.159	26.32
2011	59.69	29.84	3.612	30.18	3.316	26.13
2012	80.34	40.17	4.752	39.58	4.056	33.80

Source: KNEC Reports 2008, 2010 and 2013.

The national mean score performance is based on the raw scores of students with the maximum mark being 200 whereas the county and co-educational schools are based on mean grade values between 1 and 12. The statistics in table 1 show that the general performance in Biology has been poor at the national, county and in co-educational schools in Siaya County as depicted by the mean scores and percentage means. The performance has not been steady from 2007 to 2012 both at the national level, county and in co-educational schools. Although, there was a rise in the mean score and percentage means in 2012, the performance is still poor. `The means for co-educational schools in 2010 and 2012 were 24.32% and 33.80% respectively. In Siaya County for the same years were 29.13% and 39.58% respectively which were slightly below the national mean which are at 29.23% and 40.17% respectively. This poor performance in Siaya County has raised public outcry from stakeholders who are concerned that the county that was once a better performer in national examinations has lost its 'glory' (CEMASTEA, 2009). It also indicates that students' pursuit of professional courses related to Biology would be hampered in Siaya County and mostly from co-educational schools.

Poor performance in Biology has been linked to Lack of resources (Changeiywo, 2000; Mucherah, 2008); inappropriate teaching methods and approaches (KNEC, 2004; Orora et al., 2005; Gbore & Daramola, 2013); Changeiywo, (2000) adds the following as challenges affecting students' performance: less time allocation, lack of well trained teachers, relevance of the curriculum to the needs of the society, attitudes of students and teachers towards the subject, examination pressure and language of instruction . There are also reports that students have an inadequate understanding of Biology concepts (KNEC, 2004; KNEC, 2011).

Although a diversity of factors would influence performance in Biology, some issues that need investigation are apparent like the students' perceptions of learning environment. It has been observed students' perceptions are significant. First, students spend the longest time in the classroom and their perceptions would be based on experience over a span of many lessons and would also be an aggregate judgment of all students in a class (Fraser, 2007; Opolot-Okurut, 2010; Choo, 2011; Fraser, 2012). Secondly, students are directly involved in classroom activities and are more acquainted with what happens in the classroom and their perceptions therefore characterize the class from the actual participants' view (She & Fisher, 2002; Choo, 2011). Thirdly, students' perceptions also influence their cognitive and affective outcomes (Telli, Cakiroglu & den Brok, 2006; Telli et al, 2009; Harris, 2013). Students' perceptions are therefore crucial for a meaningful investigation of learning environment. Scholars of learning environment have proposed that in countries where learning environment studies are rare like Kenya, there is need to assess students perceptions of actual and preferred learning environments to provide teachers with data for creating interventions to improve them in the desired directions (Den brok, Telli, Cakiroglu, 2010;Afari, Aldridge, Fraser, Khine, 2012;Fraser,2012). It has been reported that achievements in national school examinations could be related to the type of school that one attends in terms of endowment of learning resources (Mucherah, 2008). However Otami, Ampiah and Anthony-Krueger (2012) note that disparities in achievement still exist among schools of the same category despite availability of basic learning resources. These disparities need investigation from a learning environment perspective.

Since the introduction of free primary education in Kenya, there has been a phenomenal increase in the number of co-educational secondary schools in the country and Siaya County to be specific with the major objective to increase access to secondary education (MOE, 2012). Most of the co-educational secondary schools have registered poor performance in Biology in the national examinations from Siaya County as depicted by means in table 1 (KNEC, 2010; KNEC, 2013). This poor performance requires investigation from a learning environment perspective. Students' perceptions of learning environment have also been found to be co-influenced by gender (Wahyudi & Treagust, 2004; Murugan & Rajoo, 2013; Harris, 2013). The proliferation of co-educational schools in the county requires an investigation with the gender perspective in focus. This would also ensure that gender does not confound the interpretation of student perceptions. CEMASTEA (2009) in a situational analysis on the status of Biology teaching in Siaya County reported the domination of teacher centered methods in Biology classrooms. At the same time, there were reports that the attitude of students towards Biology was negative as reported from the perspective of the teachers. There is need to establish this finding from the perspective of students.

The dismal performance in Biology in Siaya County requires an investigation from the dimension of the learning environment because students' perceptions of their learning environment affect students' cognitive and affective outcomes and, Students have been found to achieve better in the types of classrooms which they prefer (Puacharearn & Fisher, 2004; Gijbels, Van de Watering, Bossche & Dochy, 2006; Ozkal, Tekkaya & Cakiroglu, 2009). It also follows that in this state of performance, the noble objectives of Biology education may not be realized. In order to improve the performance of students in Biology, in Siaya County, there is need to structure the classroom environment in ways that make it more congruent with what the students prefer. This process would involve an assessment of actual and preferred learning environment and identifying discrepancies. This would help to establish the level of congruence with the students' expectations. The relevant data would provide a feedback for the teachers to use in improving learning environments.

The constructivist learning environment is understood to enhance active learning, student participation and negotiation, personal relevance, shared control and autonomy (Johnson & McClure, 2004; Kim, 2005; Palmer, 2005; Oludipe &Oludipe, 2010; UNESCO, 2010; Cavas, 2011; Moustafa, Ben-Zvi-Assaraf & Eshach, 2013). It is therefore prudent to investigate students' perceptions of Biology learning environment from a constructivist perspective as a basis for developing an intervention. In this way, students will find personal relevance in their study of Biology, share control over their learning, feel free to express concerns about Biology learning, view biological knowledge as ever changing and interact with each other to improve comprehension. This is also likely to produce a motivating effect and change the attitude of the learners towards the subject. In Siaya County, the performance of co-educational schools has been low. However, among the same co-educational schools, some schools have been identified to perform poorly whereas others have been isolated to perform better. For instance, when the middle achieving schools are excluded, the high achieving co-educational secondary schools had percentage means of 52.1%, 51.5% and 54.5% respectively for the years 2010, 2011 and 2012 respectively. Within the same years, the low achieving secondary schools had percentage means of 24.1%, 22.6% and 21.9% respectively (KNEC, 2008; KNEC 2010; KNEC, 2013). In this regard, it is important to find out how the students in high and low achieving co-educational secondary schools perceive the Biology learning environment whether there is learning environment nexus with this performance.

1.2 Statement of the Problem

Research on learning environment has demonstrated that student outcomes such as achievement, motivation and attitude are influenced by the nature of the learning environment and how it is perceived by students. Studies have also shown that students' perceptions also vary by gender. Although a high premium is placed on constructivist learning environment by scholars as a panacea to decreased learning outcomes in other domains of student learning, these benefits have not been established in relation to Biology pedagogy. In Siaya County, the performance in Biology has been poor (KNEC, 2010; KNEC, 2012). It also has a large number of co-educational schools that have been performing poorly. A closer scrutiny of schools of the same category also reveals that some of the same schools have been performing better. Despite linking low achievement in Biology to lack of resources, inappropriate teaching methods, teacher quality, there is lack of evidence to show the relationship between the students' perception of Biology learning environment and achievement, motivation, attitude of students towards Biology. This limits the opportunities for teachers to create more enabling learning environments from a point of information. There was therefore, need to investigate students' actual and preferred Biology learning environment and its correlations with Achievement, motivation and attitude towards Biology in Siaya County in the high and low achieving coeducational secondary schools as a basis for developing intervention strategies to create Biology learning environment that learners prefer in the county.

1.3 Purpose of the Study

The purpose of this study was to investigate the relationship between Biology learning environment and achievement, motivation and attitude towards biology in coeducational secondary schools in Siaya County from a constructivist perspective.

1.4 Objectives of the Study

The objectives of the study were to:-

i) Examine students' perception of Biology learning environment in the high and low achieving schools.

ii) Establish the relationship between students' perception of Biology learning environment and achievement in Biology among the high and low achieving schools.

iii) Establish the relationship between students' perception of Biology learning environment and motivation towards Biology in high and low achieving schools.

iv) Establish the relationship between students' perception of Biology learning environment and attitude towards Biology in high and low achieving schools.

v) Determine gender difference in students' perception of the Biology learning environment.

1.5 Research Hypotheses

To achieve the objectives of this study the following null hypotheses were tested.

H_01: There is no significant difference between students' perception of actual learning environment and preferred learning environment in low and high achieving schools.

H_02: There is no significant relationship between students' perception of Biology learning environment and achievement in high and low achieving schools.

H_03: There is no significant relationship between students' perception of Biology learning environment and motivation towards Biology in high and low achieving schools.

H_04: There is no significant relationship between students' perception of Biology learning environment and attitude towards Biology in high and low achieving schools.

H_05: There is no significant gender difference in perception of Biology learning environment.

1.6 Significance of the Study

The findings of the current study have provided a framework for teachers to recognize the affective components of motivation and attitude and their role in Biology education. One of the major priorities in Biology education is to be able to identify those variables and to help all students to improve their Biology learning and achievement. The practical outcomes of this research is that teachers can create Biology learning environment with respect to constructivist perspective which is also practically significant in the promotion of student motivation and attitude towards Biology. This is likely to improve cognitive outcomes.

This study also provides the teachers with a prop for promoting constructivist learning theory in Biology classrooms to help the students to be more motivated and help them realize the significance and the value of what they learn in Biology classrooms. Conceptualizing student perceptions of the Biology learning environment and its correlates like motivation and attitude can help teachers and educational researchers to discover some alternative ways that enhance cognitive outcomes by restructuring the learning environment to make it more congruent with that preferred by students. In addition, considering the fact that in 2002, the Kenya Institute of Education in Kenya reorganized and rationalized the Biology curriculum based on the constructivist approach in which students are expected to learn Biology through active involvement in the discovery process, this study will help Biology teachers to understand their student needs and expectations as far as the use of constructivist approach in Biology education is concerned.

1.7 Scope of the Study

This study involved sub-county co-educational public secondary schools in Siaya County, Kenya. Students in Kenya make choices either to do Biology or not at form 2 level (KIE, 2002). Obtaining students' perceptions prior to another significant transition of choosing subjects presents an opportunity for future comparative research. It was therefore important to incorporate the views of those who would choose Biology and those who would not do so and their reasons. The content tested in the student achievement test was on form one topics that included introduction to Biology, classification, the cell, The Cell physiology, and Nutrition in plants and animals. Form two students in high and low achieving sub-county co-educational public secondary schools in Siaya County were therefore the focus of the study.

1.8 Limitations of the Study

The study had the following limitations:

i) Individual differences exist in any learning environment. This could contribute to a lesser extent on the student responses during the study.

ii) Most of the data from this study were collected by use of closed ended questionnaires hence the possibility of self-serving bias. This was minimized by the use of student interview guide to triangulate data from the questionnaires and the students were to remain anonymous.

iii) Variations exist in any learning environment in terms of physical environment and the learning resources. This may have contributed to some extent on variations of perceptions. In this study attempts were made to minimize the effect by selecting school clusters that were as similar as possible.

1.9 Assumptions of the Study

The study was based on the following assumptions:

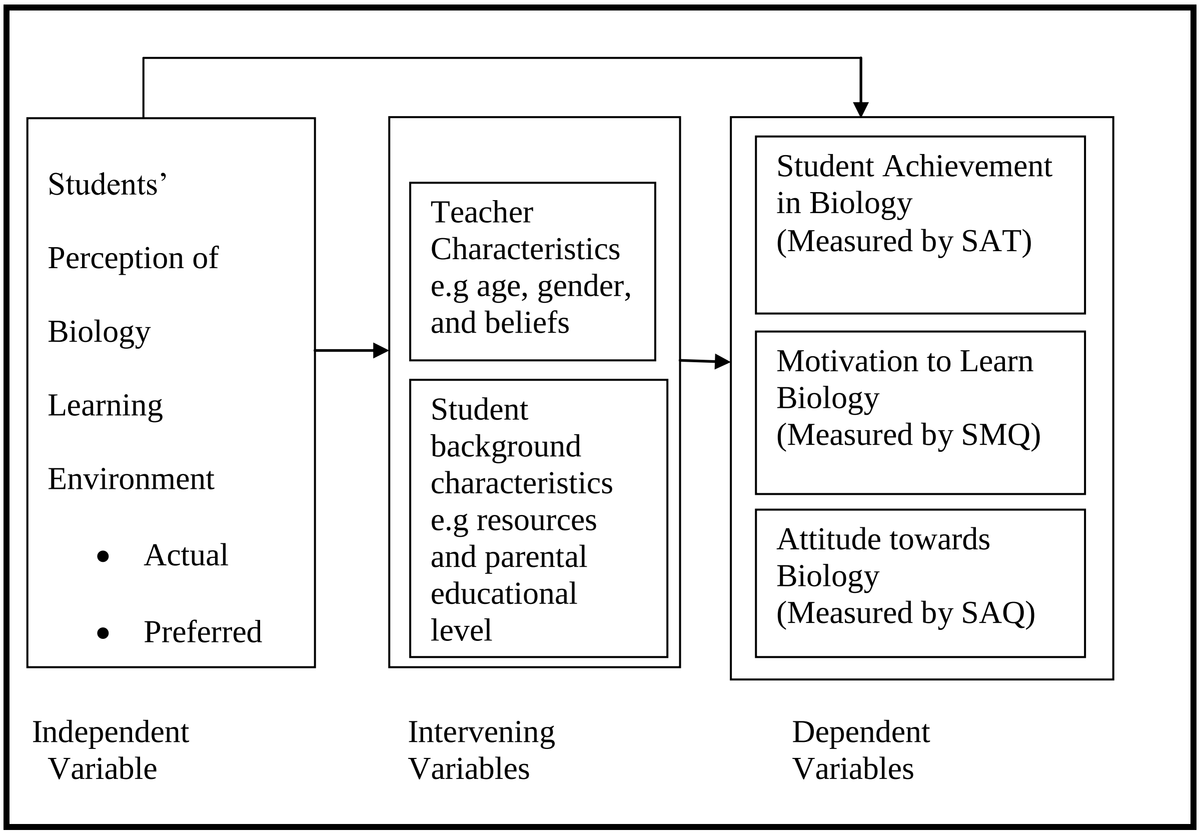
i) That the administration of instruments was done under standard conditions in which the learners gave their views without any psychological interference.

ii) That all the students involved in the study responded to the items of SPQ, SMQ, SAQ and SIG sincerely.

1.10 Conceptual Framework

According to Kim (2005), in constructivist epistemology, knowledge is constructed out of sensual and perceptive experiences of the learner. Secondly, knowledge is the personal understanding of the outside world through personal experience. Thirdly, the internally represented knowledge becomes the basis of other structures of knowledge and a new cognitive structure of the person. Fourthly, learning is an active process of developing meaning based on individual personal experiences. The conceptual framework of the study was based on the work by Phillips, Mc Naught and Kennedy (2010) on learning which conceptualized learning as having three components as the Learning Environment, Learning Process and Learning Outcomes (LEPO). The learning environment component refers to the psychosocial, pedagogical and physical context in which learning takes place. The learning process component is concerned with the interactions that occur between the teacher and the student. The learning outcome component is concerned with what the students are able to demonstrate as a result of their engagement in the learning environment with the process component. In this study, the learning environment component was related to students' perception of the actual learning environment and preferred learning environment from a psychosocial perspective. The process component was conceived to be mediated by teacher characteristics such as age, gender and beliefs. The process component was also mediated by student background characteristics such as resources and parental level of education. The learning outcome component was concerned with student achievement in Biology, student motivation to learn Biology and student attitude towards Biology arising from the student-teacher interaction within the learning environment. Diagrammatically, the conceptual framework is represented as in

Figure 1. In an ideal situation, the nature of the learning environment would affect students' achievement in Biology, motivation to learn Biology and attitude towards Biology. In a real learning environment, students' achievement in Biology, motivation to learn Biology and attitude towards Biology will be influenced by teacher characteristics like age, gender and beliefs and student background characteristics such as resources and parental level of education.



Adapted from Phillips et al (2010)

Figure 2: Learning Environment Relationship with Achievement, Motivation and Attitude

As can be seen from Figure 2, depending on how learning environment is structured the, perception of the Biology learning environment can be mediated by the influence of Teacher characteristics and student background characteristics which in turn are likely to mediate student achievement in Biology, motivation to learn Biology and attitude towards Biology.

1.11 Operational Definition of Terms

Key terms used in the study are defined as follows:

Achievement- Students' score in the Student Achievement Test (SAT). It was measured by a 25-item multiple choice test that was based on the content areas: Introduction to Biology, Classification I, The cell, Cell physiology and nutrition in plants and animals.

Actual Learning Environment (ALE) – The existing learning environment with lower levels of personal relevance, uncertainty, critical voice, shared control and student negotiation.

Attitude – An individuals' viewpoint or disposition towards a person or idea (Gall, Borg & Gall, 2003). In this study, attitude referred to students' interests, feelings and values towards Biology, Biology lessons, and the Biology teacher.

Biology- The study of living organisms. In this study, this will be limited to the content areas: Introduction to Biology, Classification I, The cell, Cell physiology and nutrition in plants and animals.

Co-educational school - An institution that provides secondary education and, learning for both genders. In this study co-educational schools referred to schools that offer learning opportunities for both girls and boys in the same Biology class.

Constructivist Learning Environment (CLE)-A learner-centered learning environment where students find personal relevance in the study of Biology, view Biology as ever changing, feel free to express concerns about their learning, share control over their learning, and interact with each other to improve comprehension in Biology.

Gender - A state of being male or female. In this study gender referred to the state of being a female or male student in form two.

High achieving Schools - The co-educational schools that scored a mean of 6.00 and above in Biology from 2010-2012 in Siaya County.

Learning environment- The psychological, physical and pedagogical contexts in which learning occurs. In this study, learning environment referred only to actual and preferred psychosocial environment of the form 2 students' Biology classroom.

Low achieving Schools - The co-educational schools that scored a mean of 5.00 and below from 2010-2012 in Biology in Siaya County.

Motivation – An internal state or condition that serves to activate, direct and sustain behavior (Palmer, 2005). In this study motivation referred to active and sustained engagement in Biology related tasks for achieving better understanding of Biology.

Perception- The state of being aware of something through the senses; a way of understanding something. In this study perception referred to how the students understand or interpret the Biology classroom environment and whether they prefer it or not.

Preferred Learning Environment- The learning environment that is desired by the students characterized by higher levels of personal relevance, uncertainty, critical voice, shared control and student negotiation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents a review of recent ideas, theories and studies that have been documented specific to the discipline of Biology education. However due to the dearth of literature in the domain of Biology education, the review extends to other areas of science that are thought to have implications for the learning environment of Biology. The review of literature is organized according to the objectives of the study. It begins with perception of Biology learning environment, relationship between students' perception of the Biology learning environment and achievement, relationship between perception of learning environment and motivation, relationship between students' perception of learning environment and attitude, and ends with gender differences in perception of learning environment.

2.2 Perception of Biology Learning Environment

The literature in this section is reviewed in terms of how Biology concepts are constructed, types of constructivism, designs of constructivist learning environment and research in learning environment.

Children construct concept meanings during the ages of birth to three years when they recognize regularities in the world around them and begin to identify language labels or symbols for these regularities (Driver & Bell, 1986). After age 3, new concepts and propositional learning is mediated heavily by language and takes place by reception learning process where new meanings are obtained by asking questions and getting clarification of relationships between old concepts and propositions and new concepts and propositions. Biology concept meanings that are constructed at any given time keep changing. In this regard, concepts grow and change in meaning as they become linked to other concepts in proposition (Inagaki & Hatano, 2006). For example, “Plants are not alive, don’t eat or move” is a proposition that contributes meaning to the young child’s developing concepts of “living things”. However this proposition takes on significantly different meaning when the child learns later. The child’s knowledge undergoes a conceptual change and restructuring and the concepts of plants and animals become joined to create a new biological concept “Living things” (Siegal & Peterson, 1999). In this regard, the construction of meaning is a continuous and active process. Therefore Biology concepts should be taught using a teaching strategy which allows the learners to relate new concepts with the prior concepts. Construction of scientific knowledge begins at an early age and is dependent on the environment where the child is socialized. This is also the time when misconceptions are likely to begin and develop. The constructivist learning environment can be helpful when teaching Biology concepts. It also depends on the degree to which learners can activate existing cognitive structures or construct new ones to subsume the new input.

According to Hoy and Miskel (2008), when many psychologists and educators use the term ‘constructivism’ they often mean different things and it is important to organize constructivist views. According to Palmer (2005), the views differ according to the extent to which they are focused on knowledge construction within individuals rather than knowledge construction within disciplines and they also vary according to extent in which they propose that knowledge is made or discovered. Most scholars hold that constructivism is not a unitary position but a continuum (Singh & Athavale, 2008; Singh & Rajput, 2013; Fok & Watkins). At the extreme ends of this continuum, two forms of constructivism have been proposed by Piaget and Vygotsky which are Cognitive and social constructivism.

The cognitive constructivist viewpoint developed from the ideas of Jean Piaget and emphasizes the importance of cognitive processes that occur within individuals. Proponents of this view (Von Glasersfeld, 1987; Kelly, 1991; Windschitl, 2002; Kim, 2005), argue that individuals always strive to make sense of the world around them by physically interacting with objects in their environment, thinking about things that have been observed and may be in conflict with those held by adults and peers. Individuals interpret these experiences in order to make meaning and develop personal understanding. Cognitive constructivism therefore emphasizes personal construction of knowledge. The teachers' role with regard to this view is therefore peripheral to provision of suitable experiences that will facilitate learning.

On the other hand, 'social constructivism' developed from the ideas of Lev Vygotsky and emphasizes the importance of society, culture and language (Palmer, 2005; Hoy & Miskel, 2008; Bass, Contant & Carrin, 2009; Santrock, 2009). According to this perspective, knowledge is socially constructed and learning takes place in particular social and cultural contexts. Social interaction provides children with ways of interpreting the physical and the social world and students thus become enculturated into ways of thinking that are common practice in that specific community. Much learning occurs when children interact with more competent individuals such as teachers. Through a process of scaffolding, a teacher can guide students to develop their knowledge and skills while making connections with students' existing schemes. Through language, students are able to share ideas and seek clarification until they understand. The emphasis is on a communication rich environment in which students are given opportunities to interact with adults and peers to negotiate meaning. The teachers' central role is providing guidance and support to learners which gradually decrease as they become more proficient.

From the foregoing, Cognitive and social constructivist views underscore different courses towards knowledge construction that is, cognitivist position asserts on auto-construction of knowledge while socialist position holds on co-construction of knowledge. However both positions have a point of convergence in the sense that the student is still required to access their pre-existing knowledge and beliefs, link these to what is currently being experienced and modify them if there is need. Thus implicit in both views is that construction of meaning requires effort on the part of the learner.

According to Brook and Brooks (1999), the model of constructivist teaching designs consists of: 1) posing problems of emerging relevance to students; 2) structuring learning around primary concepts: the quest for essence; 3) seeking and valuing students' points of view; 4) adapting the curriculum to address students' suppositions and 5) assessing student learning in the context of teaching. Brooks and Brooks (1999) describe the constructivist classroom as characterized by: presentation of the curriculum from whole to part with emphasis on big concepts; pursuit of student questioning highly valued; students viewed as thinkers with emerging theories; teachers are interactive and mediating the environment for students; students' point of view sought to understand students' present conceptions; and students primarily work in groups.

According to Yager (1991), constructivist model of teaching consists of four aspects; inviting ideas, exploring, proposing explanations and solution, and taking action. According to Driver and Oldham (1986), the constructivist model consists of five phases as Orientation, elicitation, restructuring, application and review. Cosgrove and Osborne (1985), Proposed a generative learning model in which the teaching sequence consisted of four phases: the preliminary phase , in which the teacher ascertains the pupils views through surveys; the focus phase in which the pupils' attention is focused on a phenomenon and their ideas about that phenomenon; the challenge phase, in which the pupils present their views to the group, the teacher presents the scientific view and they are discussed and compared in order to facilitate accommodation; and the application phase in which the students use the accepted scientific viewpoint to solve a range of problems. All the designs of constructivist teaching approach are characterized by the use of prior knowledge as a primer to new knowledge, active construction of knowledge and ultimately application of the constructed knowledge. It is also important to note that these models are cyclic; after the learners have reflected on the changes made in their cognitive frameworks, they compare those with their initial ideas that could lead to further construction.

Research in science education in the last twenty years on cognitive and affective abilities has been dominated by constructivist theory of teaching and learning (Palmer, 2005; Cavas, 2011). However most of these studies have tended to concentrate on the cognitive outcomes. Otami, Ampiah and Anthony-Krueger (2012) carried out a study to investigate the factors influencing elective students' perception of their Biology classroom environment in low and high achieving secondary schools in Ghana. The findings revealed that four factors viz: equity, cooperation, student cohesiveness and teacher support underlie students' perception of the Biology classroom environment. At the same time, all the students had a low perception of the Biology classroom environment. The study concentrated on the factors influencing the classroom environment in high and low achieving schools in general performance which are not necessarily low and high achievers in Biology. This could be confounding since the high or low performance could have been contributed by other domains learnt in school.

The study by Aubusson and Watson (2003) documented that the factors influencing successful implementation of constructivist innovation are attitude and motivation. They observed that in some cases the trial of constructivist pedagogy increased student interest and motivation. In these cases, the students liked their science experiences and claimed that they learnt more when using the constructivist curriculum package and students attitude to school science improved due to the constructivist classroom environment that was prevailing. In contrast cases, students' lack of interest and low motivation made it difficult to implement constructivist teaching strategy. This study did not have a background on the preferences of the constructivist learning environment. This background information would have served as a basis for the implementation of constructivist learning environment.

Wahyudi and Treagust (2004) carried out a study to investigate the perception of actual and preferred learning environment among lower secondary students of Indonesia using What Is Happening In this Class (WIHIC) questionnaire. The findings indicated the existence of statistically significant difference between the actual learning environments and preferred learning environments in favor of the preferred in all the subscales of WIHIC. This study was based on urban, sub-urban and rural areas. The study did not adequately describe the different localities of schools. This leaves room for misunderstanding of the sample characteristics again such localities may not be significantly different. A school can exist in a rural area but with similarities to an urban school. WIHIC is a leaning environment instrument that is not premised on a single theoretical position.

Ozkal (2007) carried out a study to investigate scientific epistemological beliefs, perceptions of constructivist learning environment, prior knowledge and gender as determinants of students' approaches to learning among 8^{th} grade students. The results of paired sample t-test showed that the actual learning environments of the students did not adapt their preferences. The students preferred more constructivist learning environment where they have more opportunity to relate science with the real world, communicate in the classroom, take role in the decision making process of what will go on in the lesson to be more beneficial to them, question what is going on freely and experience the formulation of scientific knowledge. Ozkal, Tekkaya and Cakiroglu (2009) carried out a study to investigate 8th grade students' perception of actual and preferred constructivist science learning environments in public elementary schools of Ankara. The results showed that students tended to prefer more constructivist learning environment in which they have more opportunities to relate science with the real world, communicate in the classroom, take role in the decision making process of what will go on in the lesson to be more beneficial to them, questioning what is going on in the lesson freely and experience the formulation of scientific knowledge. The two studies by Ozkal (2007) and Ozkal, Tekkaya and Cakiroglu (2009) were carried out among grade eight students that focused on science in general and the findings were solely based on self-reported data. Self-reported data are subject to a self-serving bias.

Kim, Fisher and Fraser (1999) investigated the perception of actual and preferred learning environments from a constructivist perspective among grade 10 and 11 Korean students using Constructivist Learning Environment Survey (CLES). The findings indicated the existence of a difference between actual and preferred learning environments for the five scales of CLES. Kim (2005) carried out a study to investigate the effects of constructivist teaching approach on student academic achievement in mathematics, self-concept and learning strategies. The results from this study indicated that constructivist teaching approach is more effective than traditional teaching in terms of academic achievement however it was not effective in relation to self-concept and learning strategies, however it had some effect upon motivation, anxiety towards learning and self-monitoring; at the same time the constructivist learning environment was preferred to a traditional classroom. The study by Kim et al (1999) was focused on science in general among grade 10 and 11 respectively whereas the study by Kim (2005) was based on manipulation of the learning environment and therefore subject to threats of experiments like experimenter bias and treatment fidelity.

Fisher and Kongkarnka (2008) investigated students' perception of their chemistry learning environment in Rajabhat University in Thailand using Tertiary Chemistry Learning Environment Questionnaire (TCLEQ). The findings revealed that for the 7 scales of TCLEQ (student cohesiveness, co-operation, equity, investigation, integration, teacher support and material environment), there were significant differences between the actual and preferred scores and that the students preferred a more positive classroom environment than was actually present. Hussain (2012) explored the significance of constructivist approach at higher education level and its effects on social learning of students among students of Islamia university of Bahawalpur using observational method of descriptive research. The researcher concluded that students enjoyed working on collaborative and cooperative projects and tasks. The students were keen on constructing knowledge by involving themselves in activities and showing their readiness to embrace constructivist approach. The collaborative and cooperative work enabled the students to overcome their shyness and introversion. The two studies focused on the learning environment at higher education level where students have experienced cognitive maturity (Luketic & Dolan, 2013) and this could influence their perceptions of learning environment. The studies also based on chemistry and social learning respectively. Learning environments in different domains evoke different perceptions depending on how they are structured.

Thenjiwe and Boitumelo (2012) carried out a study to explore the extent to which constructivist practices were present in Mathematics classrooms in Primary schools in Botswana. The findings of the study indicated that 73.5% of the lessons required learners to memorize facts, formulae and definitions, 85% of the lessons were characterized by performance of algorithmic problems without connection to the underlying concept or meaning, 23% of the lessons involved use of procedures with the purpose of developing deeper levels of understanding concepts or ideas and in only 3% of the lessons observed involved learners doing non-algorithmic thinking, students exploring and investigating the nature of concepts and relationships. Yang (2013) investigated 2324 junior secondary school students' perceptions of Mathematics classroom learning environment in China using WIHIC instrument. The findings indicated that the students did not perceive their Mathematics classroom environments very favorably. On the other hand, grade 9 students were found to perceive their Mathematics classroom learning environments less favorably than grade 7 and 8. The two studies were focused on the Mathematics learning environments. The study by Thenjiwe and Boitumelo (2012) was done in Primary Schools and used observation method which was likely to be threatened by observer bias. The study by Yang (2013) was based on junior secondary students at grades 7, 8 and 9.

Beyhan (2013) carried out a study to examine the correlation between elementary teachers' student control ideology and students' views on constructivist learning environment in Konya. The findings indicated that there was a negative moderate significant correlation between teachers' student control ideologies and students' views on constructivist learning environment. On the hand, it was found that teachers' student control ideologies predict students' views on constructivist learning environment. The study by Beyhan (2013) correlated the student teachers' and students' views of the constructivist learning environment and was not based on a particular subject domain. Domain based studies are significant since general studies can camouflage students perceptions due to non-homogenous learning environments.

Igwebuike and Ajuar (2013) carried out a study to determine secondary school chemistry students' and their teachers' perceptions of their classroom environment using actual and preferred versions of Individualized Classroom Environment Questionnaire (ICEQ). The analyses indicated that there was a significant difference between the perceptions of actual classroom environment by students and their teachers. The findings further revealed that there was a difference between the students' perception of their actual and preferred learning environments but there was no difference between perception of the actual environment by the teachers and that of the preferred environment by the students. Luketic and Dolan (2013) explored the relationship between giftedness and students' perceptions of their laboratory learning environments in Biology courses including courses designated for high achieving versus regular achieving students. The study used Science Laboratory Environment Inventory (SLEI). The findings indicated that students in high achieving courses had more favorable perceptions of all aspects of their learning environment when compared with students in regular courses. In addition, student perceptions of their laboratory appeared to be influenced by the extent of their experience in learning science. Perceptions were also consistent amongst regular and high achieving students regardless of grade level. The study by Igwebuike and Ajuar (2013) had weaknesses of small sample size and data based solely on self-reported data. The study by Luketic and Dolan (2013) was based on perceptions of the science laboratory learning environment with sampling of regular and high-achieving students regardless of their grade level. The variable of grade level could be confounding the findings.

Moustafa, Ben-Zvi-Assaraf and Eshach (2013) examined the manner in which the features of a constructivist learning environment and the mechanisms at its base are expressed among junior high school students using CLES questionnaire and interviews. The findings from quantitative analysis indicated that a considerable portion of the students perceived their learning environment as constructivist. On the other hand, the qualitative analysis indicated that some of the students do not perceive the learning environment as constructivist. The study by Moustafa, Ben-Zvi-Assaraf and Eshach (2013) was based on the premise that learning environment had been restructured to implement constructivist learning environment and therefore based on the question that ‘do they perceive it as constructivist?’ It was also not based on a particular subject domain. It was carried out among grade 8^{th} and 9^{th} pupils in urban schools from middle and high socio-economic status. The variable of location of schools could influence the students’ perceptions of the learning environment.

From the literature above, most of the learning environment researches have not specifically examined the perception of the constructivist learning environment from a Biology perspective; Most of the studies used WIHIC instrument which is not based on a single theoretical position. Neither have any of the studies focused on the students in high and low achieving co-educational schools. This study was an attempt to fill this gap.

2.3 Perception of Learning Environment and Achievement

The literature in this section is reviewed in terms of the relationship between learning environment and achievement. The studies are analyzed to identify the gaps that existed in the studies. Explanations have been made on how the study will fill the gaps at the end.

Roth(1998) conducted a study in which two classes of grade 8 students were taught by the same teacher were monitored in terms of students' perceptions of their learning environment, achievement levels and conceptual understanding. Quantitative methods and qualitative methods were combined. The findings indicated that there were relationships between the autonomy and student centeredness scales of the constructivist learning environment survey and immediate and delayed post-tests. On the other hand, the negotiation scale was not related to achievement. Kamaruzaman et al (2009) in a study determined how students assess various components of their learning environment and how learning environments affect students' outcomes among Bumuputeras students. Their findings revealed that four components (Facilities provided, housing environment, parental motivation and school and teacher factors) contribute to students' academic performance. The findings also showed that only two components of the learning environment (housing environment and school/teacher involvement) positively correlated with students' achievement. The study by Roth (1998) was based on an experimental design and therefore subject to threats to internal validity like testing, maturation and differential selection. The study did not also focus on a specific discipline. The study by Kamaruzaman et al (2009) focused on the physical components of the learning environment and parental factors and how they contribute to achievement. However it was not based on a specific subject domain.

Wahyudi and Treagust (2004) investigated the relationship that existed between learning environment and cognitive outcomes among lower secondary school students of Indonesia using WIHIC and scores on science national examinations. The findings indicated that student achievement in science examinations is significantly related to the scales of student cohesiveness, task orientation, and cooperation. Further investigation of the beta weights indicated that cooperation was the strongest predictor of student achievement in science. Chionh and Fraser (2009) carried out a comprehensive study among 2310 Singaporean grade 10 students in 75 Geography and Mathematics classes in 38 schools using WIHIC questionnaire. An investigation of associations between classroom environment and several student outcomes revealed that better examination scores were found in classrooms with more student cohesiveness. Umo (2010) carried out a study that sought to establish the relationship between students' perception of their classroom learning environment and their academic achievement in Igbo language in Enugu state schools of Nigeria. The Pearson product moment correlation coefficient and t-test statistics were used in analyzing the data. The findings indicated a significant relationship between their mean perceptions and academic achievement. The study by Wahyudi and Treagust (2004) did not use the very scores of the students involved in the survey but the scores of schools in national examinations. The study also correlated the school scores with the subscales of WIHIC. This is likely to be confounding. The study by Chionh and Fraser (2009) was based on a correlation of Geography and Mathematics perceptions of learning environments and student outcomes in the subject domains. The study by Umo (2010) focused on the relationship between the perception of the learning environment and achievement in the Igbo language.

Rita and Martin-Dunlop (2011) assessed the perceptions of 146 gifted and 115 non-gifted high school Biology students and investigated associations between student perceptions and cognitive achievement. The data indicated that all students preferred a more favorable learning environment than they were currently experiencing but gifted students perceived their actual environment more positively than the non-gifted students. Statistically significant associations between the actual learning environment and achievement on a standardized Biology test were found for majority of the scales. Teacher support, investigation and equity were all statistically significant independent predictors of student achievement while student cohesiveness had negative associations with achievement. The study by Rita and Dunlop (2011) was based on sample of gifted and non-gifted students whose determination was based upon ranking on scores for Reading, Language arts and Mathematics. The selection into the groups was not based on their performance in Biology. There was a likelihood of students being gifted in the other subjects and not gifted in Biology and vice versa.

Adeyemo(2011) conducted a study to investigate the effect of students' perceptions of Physics classroom learning environment and how it affects their achievement in Physics. The findings indicated that there existed a significant difference in students' perception of Physics classroom environment and their academic achievement. The researcher concluded that students' perception of classroom learning environment has an effect on the students' academic achievement. Helding (2006) investigated the relationship between the perception of science learning environment and achievement in science among 927 grade 8 and 10 students of Florida using WIHIC instrument and scores from the science portion of the Florida comprehensive assessment test (FCAT). The findings indicated positive and statistically significant correlations for involvement, investigation and equity for the student level analysis. On the other hand, for class mean as the unit of analysis, there were no significant correlations between student achievement and any of the learning environment scales. The study by Adeyemo (2011) was based on the Physics learning environment and did not adequately describe the instrument used for assessment of Physics achievement. The study by Helding (2006) had the variables of ethnicity and socioeconomic status threatening the internal validity of the study and could also confound the interpretation of results.

Bas (2012) investigated the correlation between the perception of constructivist learning environment and academic success of elementary students in science course with structural equation modeling. Two instruments-Constructivist Learning Environment survey (CLES) and school report cards were used. The data were analyzed using LISREL 8.5. The findings indicated that the compatibility index results of the constructed structural equation model were high enough. An examination of the structural equation modeling revealed that the variable that best predicted elementary students' academic success in relation to constructivist learning environment was personal relevance followed by critical voice, student negotiation and shared control respectively. The study by Bas (2012) was based on elementary students' correlation of CLES scores and scores of students' in report cards. Academic success was measured based on the scores present in the report cards. There was no indication on whether the scores were results of standardized tests or whether the conditions in which the tests were taken were uniform.

Igwebuike and Oriaifo (2012) conducted a study to find out if the constructivist learning environment could enhance cognitive and affective achievements of students in non-conducive environments. Two instruments- Cognitive Achievement Test and Affective Achievement Test were used. The findings indicated that the constructivist learning environment does not improve cognitive achievement. Tran (2013) in a study surveyed the relationship between students' perceptions of the learning environment of mathematics classroom and achievement in mathematics. The findings indicated that when the students perceive the environment as relatively more cohesive and satisfied they tend to have higher achievement. In contrast, when students perceive the learning environment as relatively more competitive and difficult they tend to have lower achievement. The study by Igwebuike and Oriaifo (2012) was based on non-equivalent control group experimental design in which one researcher administered the treatments. This introduced the teacher-effect variable to the study. The cognitive achievement test was limited to the major concept of Energy. The study by Tran (2013) used the instrument My Class Inventory (MCI) to measure the perceptions of the learning environment which is not based on a single theoretical construct. The mathematics achievement test was focused on the content of Mathematics knowledge.

Murugan and Rajoo (2013) compared Mathematics learning environment and Mathematics achievement among students of Sipitang, Malaysia. The study used a Mathematics questionnaire based on What Is Happening In this Class (WIHIC) and Constructivist Learning Environment Survey (CLES) and a Mathematics achievement test. The findings indicated significant weak correlations between Mathematics classroom learning environment and Mathematics achievement. Harris (2013) carried out a study to explore the nature of the relationship between students' classroom perceptions and preferences and their academic performance outcomes among grade eight students in New England using the instrument, Constructivist Learning Environment Survey (COLES) and standardized English test. The findings indicated significant differences between students' perceptions and preferences within their classroom. The study by Murugan and Rajoo (2013) used an instrument which was a blend between WIHIC and CLES. The CLES items were 17 whereas WIHIC items were 59. The implication is that the entire instrument was biased towards WIHIC and the overall perception was more leaning towards WIHIC than CLES. The study by Harris (2013) was based on constructivist learning environment among grade 8 students and based on English learning environment. The major weakness of the study was that it based on convenience sampling in which case it was conducted at a site accessible to the researcher. In this regard, generalization to other populations would be difficult.

Pamuk (2014) carried out a study to investigate the relationship between perception of constructivist learning environment and students' science achievement among 7th grade students of Cankaya and Yenimahalle districts of Turkey. The study used Constructivist Learning Environment Survey (CLES) and a 14–item multiple choice science achievement test. The findings indicated that the student negotiation scale significantly predicted students' science achievement score. This study was highly dependent on self-reported data hence threatened by a self-serving bias. The science achievement test had more items that were learning towards Physics than Biology hence the aggregate score would not be attributable to a particular domain. The sample of the study was mainly composed of students from the city which implied socio-economic status would be a variable that would confound the interpretation of the results. This also posed a serious threat to internal validity.

From the foregoing, it can be seen that most of the studies did not focus on the Biology learning environment from a constructivist theory. This study departed from the rest in the sense that it examined the classroom environment from a constructive perspective among coeducational secondary schools in high and low achieving schools in Biology.

2.4 Perception of Learning Environment and Motivation

The literature in this section is reviewed in terms of the theories of motivation and motivational constructs and the research in the relationship between perception of the learning environment and motivation. The theories have been analyzed and the studies have critically analyzed to identify the gaps that existed and how the current study attempted to fill the gaps.

Different theories explain motivation in different ways. According to the behaviorist theory, external rewards and punishments are keys in determining a students' motivation (Santrock, 2009). Advocates of behaviorist perspective emphasize that the use of incentives add interest and excitement to the class and direct attention towards appropriate behavior and away from inappropriate behavior (Emmer & Evertson, 2009).

The humanistic theories stress students' capacity for personal growth, freedom to choose destiny and positive qualities. This perspective is closely associated with Maslow's theory that certain needs must be met before higher needs can be satisfied. According to Maslow, individual's needs must be satisfied in the sequence of psychological, safety, love and belongingness, esteem and self- actualization (Maslow, 1971). Self-actualization, the most elusive of Maslow's needs, is the motivation to develop one's full potential as a human being. However not everyone agrees with this theory since for some students cognitive needs might be more fundamental than needs for esteem. Other students might meet their cognitive needs without experiencing love and belongingness (Santrock, 2009).

According to the cognitive theorists, students' thoughts guide their motivation. They argue that students should be given more opportunities and responsibility for controlling their achievement outcomes (Patall, Cooper, & Robinson, 2008). The cognitive perspective stresses the importance of goal setting, planning and monitoring progress towards a goal (Santrock, 2009). It also stresses that people with an internal motivation are able to deal effectively with their environment, to master their world and to process information efficiently.

The social theorists argue that students' need for affiliation or relatedness is reflected in their motivation to spend time with peers, close friendships, attachments to parents and their desire to have positive relationship with their teachers (Santrock, 2009). In a study, it was found that a key factor in students' motivation and achievement was whether they had a positive relationship with the teacher (McCombs, 2001). Nelson and Debacker (2000) observe that educators who explicitly help students to understand the utility and attainment value of studying science may assist them in internalizing values that will support them as students.

According to the social cognitive theory, students' motivation is directly linked to their ability to self-regulate their learning activities (Zimmerman, 1989). Generally; self-regulated learning describes how learners meta-cognitively, motivationally and behaviorally improve their own academic achievement. Meta-cognitively, self-regulated learners plan, organize, self-evaluate and self-monitor at various stages of the learning process. Motivationally, they perceive themselves as competent, self-efficacious, autonomous and value their academic pursuits. Behaviorally, they select structure and sometimes even create environments that optimize learning (Zimmerman, 1989). The social cognitive framework assumes that motivation and learning strategies are not static traits of the learner but that motivation is a dynamic and contextually bound construct. At the same time learning strategies can be learned and brought under control by the student (Duncan & McKeachie, 2005).

It appears that, the behaviorist theories emphasize the importance of extrinsic motivation in achievement whereas the humanistic and cognitive approaches stress the importance of intrinsic motivation in achievement. The behavioral theory emphasizes on environmental factors such as rewards and punishments; the humanistic theory stresses the capacity for personal growth, freedom to choose our own destiny and our positive qualities; the cognitive theory focuses on internal drive to achieve, attributions, beliefs and self-regulation; the social theory emphasizes the need for affiliation to others. The social cognitive theory holds that motivation is a fluid, changeable and related to the context of the learning environment.

A variety of constructs have been proposed that have the potential to inform motivation in school settings. Firstly, motivation has been described as self-efficacy; this refers to the belief in one's ability to perform effectively. It is concerned with a persons' belief that he/she can organize and execute courses of action required to deal with prospective situations that contain stressful elements (Bandura, 1982); secondly, motivation has been related to achievement goal. This implies an innate drive to accomplish something to satisfy intrinsic needs for improving their own competence (Deci, Koestner & Ryan, 2001); Thirdly, Motivation has been associated with task value. This refers to whether one can perceive the value of the activity they engage in. In respect of science it relates to whether the students can perceive the value of science learning they engage in (Wigfield & Eccles, 2000).Fourthly; motivation is related to performance goal. This implies the desire to do better than others and to impress the teachers (Brophy, 1998). Fifthly, motivation is related to active learning strategies. Students who are motivated employ a variety of strategies to construct new knowledge based on their previous understanding (Tuan, Chin & Shieh, 2005). Lastly, Motivation is stimulated by the learning environment. The environment surrounding students such as curriculum, teachers, teaching and student interaction influences student motivation in science learning. The different motivational constructs have the potential to inform motivation in a Biology classroom setting.

It has been observed by many researchers (Palmer, 2005; Tuan, Chin & Shieh, 2005; Tella, 2007; Akbas & Kaan, 2007; Kember, Ho & Hong, 2010; Cavas, 2011) that of all the personal and psychological variables that have attracted studies in science education, motivation seems to be gaining popularity and leading other variables. A study by Ben-Ari (2003), examined differential effects of learning environment on student achievement motivation. The findings of this study revealed a significant correlation between the students' perceived classroom goal structures and their personal goal orientations and motivational patterns. This indicated that the more the students perceived their classroom as having a mastery goal structure, the higher was their personal mastery goal orientation and the lower was their performance avoid goal orientation and the higher was their adaptive motivational patterns. In comparison, the more the students' perceived their classroom as having a performance goal structure, the higher was their personal performance approach and performance avoid goal orientations. Thus the more the students adopted a personal mastery goal orientation, the more willing they were to exhibit adaptive motivational patterns whereas the more students adopted performance avoid goal orientation, the less they were willing to exhibit adaptive motivational patterns.

In a study that focused on the relationship between classroom environment perceptions, self-regulation and science achievement by Gungoren and Sungur (2009) classroom perceptions were measured in terms of motivating tasks, autonomy support and mastery evaluation. Self-regulation was conceptualized as consisting of two main components, namely motivation and strategy use. The findings indicated that students' perception of classroom environment concerning motivating tasks, autonomy support and mastery evaluation were positively associated with motivational and cognitive components of self-regulation and achievement. This study was done among elementary students. Motivated strategies for Learning Questionnaire (MSLQ) and Approaches to Learning Instrument (ALI) were used to measure different domains of student motivation where as students' perceptions of learning environment were measured using Survey of Classroom Goals Structures. The socio-economic status of the sample was largely middle class and this was likely to mediate their motivational orientations and their perceptions of learning environment.

In a study by Wei and Elias (2011) an examination of the relationship between students' perception of the classroom environment and their motivation in learning English language was carried out. The sample was made up of 140 form four students' in a secondary school in Malacca. The data were collected using questionnaires. The findings indicated that a majority of the students perceived their classroom as having affiliation and they were extrinsically motivated. The findings also revealed that students' affiliation and task orientations in the classrooms were positively and significantly correlated with their motivation. On the other hand, students' involvement was negatively correlated with their motivation. A study by Okurut-opolot (2010) investigated whether there was an association between mathematics classroom environment and motivation to mathematics using WIHIC questionnaire. Simple correlation analysis showed that students perception of some WIHIC scales were significantly associated to students' motivation. The study by Wei and Elias (2011) focused on form 4 students and the English learning environment. The study also used Motivated Strategies for Learning Questionnaire (MSLQ) to measure motivation and Actual Classroom Environment Scale (ACES) to measure perceptions of the learning environment. The study by Okurut-opolot (2011) was based on the Mathematics learning environment and limited to only two schools with 81 students (19 male and 62 females). This limits its generalizability and on the other hand, the effect of gender could confound the interpretation of results since it was not built into the study.

A study by Koul, Roy and Lerdpornkulrat (2012) investigated the relationship between students' perception of classroom learning environment and motivational achievement goal orientation towards Biology and physics among students in Thailand. The findings suggested that motivational goals are linked to differences in students' perceptions of learning environment and levels of Biology and physics classroom anxiety. This indicates that motivational goal orientations and perceptions of learning environment are domain specific for the two science content areas. This study focused on both Physics and Biology learning environments with special focus on motivational achievement goal orientations towards the two subject domains. The classroom perception surveys focused on relevance, autonomy in the classroom, student involvement, cooperation, competition and the anxiety scale.

Fok and Watkins (2010) investigated whether critical constructivist learning environment could be successfully implemented in two Economics secondary classrooms of Hong Kong Chinese students. The students in the high ability class reported changing to meaning oriented learning motivation and strategies compared to those in the lower ability classes. This study was done among form 4 students who were enrolled for Economics and assigned into ability classes based on their Economics examination results at the end of the year. A single observation in performance was not enough to assign the students into the ability groups. There was need to observe a trend of performance for some time. The study used CLES to measure students' perceptions and Learning Process Questionnaire (LPQ) to determine their change in learning strategies. This study was also an experimental study and therefore subject to threats of experiment like testing and statistical regression.

From the foregoing, the literature above has shown that there is a strong relationship between a positive classroom environment and beneficial motivational patterns. However none of these studies looked at the Biology classroom environment from a constructive perspective. This study was an attempt to fill this gap by looking at the relationship between the perception of the Biology constructivist learning environment and student motivation in high and low achieving schools in Biology.

2.5 Perception of Learning Environment and Attitude

The literature in this section is reviewed in terms of the concept of attitude and the relationship between perception of learning environment and attitude. The studies have been analyzed with view to identify the gaps in literature. Explanations have also been given to show how the current study will fill the gaps.

According to Gall, Borg and Gall (2003) attitude is an individuals' viewpoint or disposition towards a person or idea. It contains three domains: affect cognition and connotation. Affect refers to the persons feeling about the object. Cognition is the persons' beliefs and knowledge about the object, and connotation is the behavior which an individual shows towards the object. According to Arisoy (2007) these three components of attitude have been taken into consideration in instruments which measure attitude. According to Osborne et al (2003) Attitude is a combination of sense, belief and values towards an object that is a product of science, science class or an effect on science and scientists. According to Arisoy (2007) research in attitudes towards science has been increasing in literature. Arisoy advances four reasons why this is so. Firstly, attitudes towards science influence behaviors such as selecting courses and supporting scientific inquiry; secondly, a relationship between attitudes and science achievement has been found to exist. Students with positive attitudes towards science tend to have higher scores on science achievement; thirdly, research related to attitudes towards science indicates that an increasing number of students are not interested in science. Many students especially females associate science with negative feelings which discourage them from continuing with scientific inquiry; fourthly, there is a decrease in positive attitudes towards science with increasing grade level for both boys and girls. KIE (2006) argues that a positive attitude towards Biology is evidenced by interest in biological activities, willingness to explore the unknown, asking questions, willingness to cooperate with others, honesty in report presentation and demonstration of self-confidence. Klopfer (1976) developed six categories of conceptually different attitudinal aims for the concept of ‘attitude towards science’ these are: manifestation of a favorable disposition towards science and scientists; acceptance of scientific inquiry as a way of thought; adaptation of scientific attitudes; enjoyment of science learning experiences; development of interest in science and science related activities; and development of interest in pursuing a career in science. Implicit in these conceptions of attitude is the consensus that attitude is a learned disposition to feel, think or behave favorably or unfavorably towards something again that attitudes towards science comprise feelings, beliefs and values held about the enterprise of school, science and the impact of science in the society.

Kim, Fisher and Fraser (1999) investigated the association between constructivist learning environment and attitude towards general science in Korea using the *actual* constructivist learning environment survey (*actual*-CLES) and Test of Related Science Attitudes (TOSRA) among grade 10 and 11 students. The findings indicated statistically significant relationships between students' perceptions of learning environment and their attitudes towards science for most of the CLES scales. The beta weights revealed that personal relevance was the strongest independent predictor of students' attitudes towards science. This study focused on the relationship between actual constructivist learning environment and students attitudes towards science in general. The study did not reveal the relationship between attitude and the preferred learning environment. It is prudent to show how students' perceptions of preferred learning environment relate with their attitudes.

Wahyudi and Treagust (2004) investigated the relationship between learning environment and attitude among lower secondary Indonesian schools using WIHIC and TOSRA. The findings indicated that all the scales of WIHIC were statistically significantly associated with three scales of TOSRA except leisure interest in science scale. The multiple regression analyses produced significant multiple correlations for students scientific inquiry attitude, students enjoyment during science lessons and student leisure interest in science. Further investigation of the beta weights revealed that investigation and equity scales of the learning environment were strong predictors of students' scientific inquiry attitude. This study was based on attitudes towards science in general. The study used WIHIC instrument which is not based on a single theoretical position or stance.

Kithaka (2004) working for the Strengthening of Mathematics and Science in Secondary Education (SMASSE) project in Kenya argued that there is a general attitude among students that science subjects are difficult. This feeling according to Kithaka is a result of poor performance at national examinations, where anticipation of negative outcomes inhibits learning effort. Other factors are saturation of the job market which discourages students, socio-cultural attitudes and too much theoretical teaching of sciences. Implicit in the arguments of Kithaka is that positive attitude towards Biology is related career prospects of learners, difficulty level of the subject and pedagogical strategies that dominate the learning environment. In a study, Chuang and Cheng (2003) investigated the relationships between students' attitude towards Biology and classroom learning environment of 7th grade students in Taipei. The study employed the Attitudes Towards Biology scale (ATB), What Is Happening In this Class (WIHIC) and Learning Environment Questionnaire (LEQ).The findings indicated that associations between attitude towards Biology and perceptions of learning environment were significant with a correlation of 0.31. Furthermore the findings showed a significant correlation between attitude towards Biology and variables related to student interest in learning Biology. The study was done among grade 7 students and used two learning environment instruments.

Telli, Cakiroglu and Den brok (2006) examined Turkish high school students' perceptions of their classroom environment in Biology to investigate the relationships between these perceptions and students' attitudes towards Biology. Data were collected using what is happening in this class (WIHIC) and Test of Science Related Attitudes (TOSRA). Correlation and regression analyses revealed that students' perceptions of their learning environment were significantly associated with attitude. The study was done among grade 9 and 10 students and used WIHIC instrument that does not have a single theoretical position. The sampling of school clusters for the study was based on convenience sampling which has problems of generalization of the study findings and replication of the study. It was also based on self-reported data only. The data were not triangulated. Helding (2006) investigated the relationship between perception of science learning environment and attitude among 927 grade 8 and 10 students of Florida using WIHIC and attitude scale based on TOSRA. The findings indicated that a positive and statistically significant correlation existed between students attitudes towards science and all the 7 learning environment scales with either the individual or the class mean as the unit of analysis. The sample of the study consisted of 60% Hispanic and African-American and 70% of the sample was from low socio-economic status. These variables of ethnicity and socio-economic status could confound the interpretation of results.

Ozkal (2007) carried out a study to investigate scientific epistemological beliefs, perceptions of constructivist learning environment, and attitude as determinants of students' approaches to learning. The results of the study indicated that the students who had positive attitude towards science associated new knowledge with existing ones, question what is going on in the lessons, relate science to real world, and communicate in the classroom. The findings also indicated that attitude towards science was a predictor of the rote learning approaches of the students while predicting their meaningful learning approaches. There was a greater positive correlation between meaningful learning orientation and attitude towards science ($r=0.486$, $p<0.01$) than the positive correlation between rote learning approach and attitude towards science ($r= 0.196$, $p<0.01$). This implies that if the students have greater attitude towards science then the students learn meaningfully and if they have slightly positive attitudes towards science then they learn by rote. This study was limited to grade 8 students and was solely based on self-reported data which can lead to a self-serving bias.

Ntow (2009) investigated the association between students' perception of their mathematics classroom environment and attitude towards core mathematics among secondary schools in Ghana. The study used a 40-item Mathematics Classroom Environment Inventory (MCEI) and a 12-item Mathematics Attitude Questionnaire (MAQ). The results from the spearman's rank correlation tests indicated no association between students' perception of the classroom environment and attitude towards core mathematics. The study was based on a Mathematics learning environment and the attitude instrument measured students' attitude towards Mathematics. Zeidan (2010) investigated the relationship between attitudes toward Biology and perceptions of Biology learning environment among grade 11 students in Tulkarm district, Palestine. The study used a 30-item attitude towards Biology questionnaire and a 32-item Learning Environment Questionnaire (LEQ). The association between attitude toward Biology and the Biology learning environment were significant with a correlation coefficient of 0.366. The findings of this study are limited to grade 11 students. The learning environment instrument used in this study was developed from WIHIC and was not based on a single learning theory. The sample was based on refugee victims. The perceptions of their learning environment were likely to be confounded by their status.

Smith and Ezeife (2010) investigated the relationship between students' perceptions of their classroom environment and their attitudes towards science in grade nine applied science classrooms in Ontario. They used WIHIC questionnaire and Test of Science-Related Attitudes (TOSRA). The findings indicated statistically significant relationships between adoption of scientific attitudes and the classroom environment measures of investigation, equity, cooperation, task orientation, teacher support and involvement dimensions of WiHIC. This study was limited to grade 9 students and was based on the general science learning environment. It was also limited to urban schools. The interpretation of the results and generalization can be confounded in two ways. The study sample was based on the convenience of time and the classrooms used in the study contained a mix of cultures and genders.

Choo (2011) carried out a study to determine the association between the perceptions of constructivist learning environment using the CLES (actual form) and attitude to science with regard to enjoyment of science among 333 eleven-year olds in primary schools of Singapore. The findings from simple correlations indicated there was no significant correlation between the CLES (actual form) and enjoyment of science lessons. Multiple regression analysis showed that the proportion of variance in student enjoyment of science lessons explained by the CLES scales was negligible. The study by Choo (2011) had weaknesses in the related to flaws of using one method based on self-reported data from questionnaires. This is likely to lead to a situation where the respondents give responses that would please their teachers or make themselves appear good. Secondly the study had a weakness of representativeness of the sample. Thirdly, the study focused on science in general and not on a specific domain in science.

Santiboon et al. (2012) carried out a study to determine associations and relationships between students' perceptions and attitudes towards Physics laboratory learning environment in Udon Thani Rajabhat University, Thailand. Data were collected using Physics Laboratory Environment Inventory and Test of Physics-Related Attitude. The findings indicated that 3.35 % of the variance in students' attitude was attributable to their perceptions of the actual Physics laboratory classroom environment. This study used an instrument, Physics Laboratory Learning Environment (PLEI) which had three forms 2 actual forms and a preferred form and a modified form of TOSRA. It focused on university students who are likely to have experienced cognitive maturity that is likely to influence their perceptions of learning environment. Tran (2012) investigated the hypothesis that students' perceptions of the learning environment of Mathematics classroom may predict their attitudes and self-esteem towards Mathematics. The results obtained from correlation and multiple regression analyses indicated that if students were satisfied with Mathematics learning, if they found Mathematics class as cohesive, then their attitudes towards Mathematics would be positive. In contrast, if they perceived Mathematics as difficult and the learning atmosphere as competitive their attitude towards Mathematics would be negative. This study used an instrument, My Class Inventory (MCI) and The Aiken Attitude Scale (AAS). The study was done among grade 9 students of Vietnam and focused on the Mathematics learning environment.

Uredi (2013) investigated the effect of attitudes of classroom teachers towards constructivist approach on their level of creating a constructivist learning environment. The findings revealed that attitudes towards the constructivist approach was positive and there also existed a significant relationship between attitude towards the constructivist approach and sub-dimensions of constructivist learning environment scale such as discussion and interviews, sharing opinions with others, reflecting and motivating for the discovery of concept, meeting the needs of the learners and creating a meaning and correlation with real life situations. This study was focused on classroom teachers and their attitudes towards constructivist learning environment. In most of the learning environment studies, the teachers perceive the actual learning environment to be in consonance with the preferred learning environment. Hence their perceptions may not reflect the true picture of the learning environment. Afari et al. (2013) investigated whether the introduction of games into college-level Mathematics classes was effective in terms of improving students' perception of learning environment and their attitudes towards mathematics in United Arab Emirates. The findings indicated a positive and statistically significant correlation between WIHIC scales and attitude scales of enjoyment of Mathematics lessons and academic efficacy. This study was based on an experimental design and therefore subject to weaknesses of experimental design like statistical regression, maturation, selection, experimenter bias. It was carried out among college students who had matured cognitively and this could influence their perceptions.

From the foregoing, most of the studies did not focus on Biology learning environment from a constructivist perspective. None of the studies focused on the high and low achieving co-educational secondary schools. This study was an attempt to fill this gap.

2.6 Gender Differences in Perception of Learning Environment

The literature in this section has been reviewed in terms of gender. Various studies have been reviewed with regard to perception of learning environment and the effect of gender. Analysis has been done with view to creating gaps in literature and how the current study attempted to fill the gaps.

Quek, Wong and Fraser (2002) investigated differences in boys' and girls' perceptions of their Chemistry laboratory learning environment using Chemistry Laboratory Environment Inventory (CLEI). The findings indicated statistically significant differences between boys' (312) and girls' (185) perceptions of their Chemistry laboratory learning environment in favor of girls. The interpretation of the study findings could be confounding due to incomparable number of boys and girls in the sample. On the other hand, the class sizes in one of the sampled schools were small. This could have some influence on statistical analysis on perceptions of Chemistry laboratory environment. According to Luketic and Dolan (2013) Biology laboratory learning environments have more open-ended investigations compared to Chemistry and this can influence perceptions of learning environments.

Huang (2003) conducted a study to investigate factors such as school, subject, and several academic background variables that can be related to classroom learning environment of middle school students of Taiwan and whether relationships vary by gender. Three learning environment instruments were used: Classroom Environment Scale (CES), Instructional Learning Environment Questionnaire (ILEQ), and What Is

Happening In this Class (WIHIC) were used. The study indicated that girls perceived their classroom learning environment more positively than boys did. Girls were more involved, more affiliated and more cooperative with classmates than boys were. The study by Huang (2003) focused on grade 7 students. The instrument WIHIC is a mongrel of many versions of learning environment questionnaires and is not anchored on a single theoretical position.

Koul and Fisher (2003) carried an interpretive study to explore the nature of classrooms in Jammu, India. The study explored the relationship between perceptions and attitudes and gender using WIHIC questionnaire. The findings indicated that there were significant statistical differences in the scales for cohesiveness, task orientation, cooperation and equity. The magnitude of the gender difference was relatively large in favor of female students. The results suggested that girls on the whole had more positive perceptions of their science classes than did boys. This study was done among grade 9 and 10 students in 7 different co-educational private schools. In such a situation there is a possibility of gender differences in perception being attributed to either grade level or gender since the interactive effect of grade level and gender are not factored in the analysis. In another study on the perception of the learning environment, Wahyudi and Treagust (2003) investigated gender differences of students' perceptions towards science learning environment in which WIHIC questionnaire was administered in lower secondary schools in Indonesia. The study showed that female students held positive perceptions of both actual and preferred learning environment. This study was based on science learning in general. It was undertaken among rural, suburban and urban schools of Indonesia yet there was no multivariate analysis of gender and school locality. The variable of locality could confound the effect of gender.

Den Brok et al (2005) investigated background variables that have an effect on students' perceptions of the learning environment such as student and teachers' gender, ethnic background, socio-economic status and student age in Carlifonia. The study utilized the WIHIC questionnaire. Data were analyzed using hierarchical analysis of variance. The findings of the study indicated that the variable that consistently affected students' perceptions regardless of the element of interest in the learning environment was student gender. Student gender was found to be associated with student cohesiveness, teacher support, task orientation, and cooperation. Girls reported to perceive their learning environment more positively than did boys in the same science classes. This study focused on middle school science students of grade 8 classes. This study was based on convenience sampling. This reduces the generalization of the findings and replication of the study becomes difficult. On the other hand, the sample was not representative with respect to the variables such as ethnicity and average class size.

A study by Arisoy (2007) on the 8th grade perception of the learning environment, gender had a significant effect on the constructivist learning environment; specifically, girls' perception of their learning environment was higher than boys. The study by Arisoy (2007), was based on constructivist learning environment however was limited to grade 8 students and science learning environment in general. It was also based on self-reported data hence was subject to self-serving bias. Fisher and Kongkarnka (2008) investigated whether there were gender differences in perception of the chemistry learning environment in Rajabhat University in Thailand using the Tertiary Chemistry Learning Environment Questionnaire (TCLEQ). The findings indicated that both male and female students preferred more of all aspects measured by the learning environment scales. However, female students' perceptions were greater than male students on six of the 7 learning environment scales (student cohesiveness, co-operation, equity, investigation, integration, teacher support and material environment). The study by Fisher and Kongkarnka (2008) was based on Chemistry learning environment among university students who are likely to have matured cognitively. Again the study was based on self-reported measures that were prone to self-serving bias.

Telli, Den brok, Tekkaya and Cakiroglu (2009) carried out a study to investigate the effects of gender and grade level on Turkish secondary school students' perceptions of their Biology learning environment using WIHIC questionnaire. Two-way multivariate analyses of variance (MANOVA) indicated statistically significant gender (Wilks' Lambda= 0.923, F= 12.505, p= 0.000) and grade level (Wilks' Lambda= 0.958, F= 3.243, p= 0.000) differences with respect to collective dimensions of the WIHIC. The study was solely based on self-reported data hence subject to self-serving bias. The study also focused only on the actual learning environment yet the WIHIC instrument that was used has both actual and preferred forms. Previous learning environment studies have shown that learners excel in learning environments that they prefer. Hence it is prudent to find out what learners prefer with regard to their environment.

Brown, Williams and Lynch (2011) investigated students' perceptions of learning environments at an Australian University in which various aspects of the environment like courses, year levels, educational background and gender were compared using Dundee Ready Education Environment Measure (DREEM). The findings indicated that the total scores were significantly higher for females (M = 138.8; SD = 17.2) than males (M = 132.3; SD = 20.7; $t_{(545)} = 3.51$; $p = 0.002$) and this trend was consistent across all aspects of perceived learning environment. The study by Brown, Williams and Lynch (2011) was based on convenience sampling and therefore poses problems of generalizability and replication. It used self-reported data and therefore subject to self-serving bias. The instrument used is mostly common in the study of learning environments of health professionals and medical students. The study was done among university students pursuing medical courses.

Yang (2013) carried out an investigation to find out junior secondary school students' perceptions of Mathematics learning environment in China using WIHIC instrument. The findings indicated that boys perceived the Mathematics learning environment as more inquiry oriented and perceived themselves as relatively more mathematically involved. On the other hand, girls perceived more opportunities for cooperation and knew what was needed to compete in Mathematics classes. The study used WIHIC questionnaire in a Mathematics learning environment. It also took into consideration factors such as school academic background, school reputation and teachers teaching experience. Despite the consideration of these variables, they were not included in the analysis of data. The participants were drawn from urban schools. The locality of the schools could be a contributor to the perceptions of the learning environment.

Murugan and Rajoo (2013) compared Mathematics learning environment and Mathematics achievement from the perspective of gender among students of Sipitang, Sabah, Malaysia. The study used a 76-item Mathematics questionnaire based on WIHIC and CLES and Mathematics achievement test. The findings indicated that female students achieved better than their male counterparts but there were no significant gender differences in perception of Mathematics classroom learning environment. The study by Murugan and Rajoo (2013) sampled form four students and was based on the Mathematics learning environment. A study by Harris (2013) focused on the relationship between students' perceptions and preferences and academic performance in English from a gender perspective among grade eight students in urban New England schools using the instrument Constructivist-Oriented Learning Environment Survey (COLES) and standardized English test. The study was done from a gender perspective. The findings reported gender differences relative to students personal environment fit (PE fit). The girls reported significantly greater person- environment fit variances than boys in the scales of teacher support and involvement. Alternatively, boys person-environment fit relative to task focus was correlated with the measures of academic achievement, whereas none of the girls' person-environment fit measures correlated with the measures of academic achievement. The study has a weakness that it was based on convenience sampling which is not generalizable to other populations. Secondly, the girls and minorities were underrepresented as compared to the total population. The sampling error can confound the interpretation of the results.

Kwan and Wong (2014) investigated secondary school students' perceptions of their constructivist learning environment in liberal studies among 967 students of Hong Kong using constructivist learning environment survey (CLES). Analysis for gender differences using t-tests indicated non-significant gender differences. This study has weaknesses in three ways. Firstly, the findings of this study were based on self-reported data which is subject to self-serving bias. Secondly, the percentage difference of the sample in terms of gender (12%) could confound the interpretation of the findings. Thirdly, the data was obtained from a convenience sample which could limit the generalization of the findings to a wider population.

From the foregoing, most of the studies reviewed above concentrated on the gender differences in perception of the science classroom environment in general or the learning environment in general. Most studies used WIHIC instrument which is not anchored on a single theoretical position On the other hand none of the studies considered the learning environment from the constructivist perspective. These studies reveal a trend that requires a further research to produce unequivocal findings. This study specifically looked at the gender differences in perception of Biology learning environment from a constructivist perspective in high and low achieving co-educational secondary schools.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes aspects of methodology applied in the study and specifically discusses research design, study area, population, sample size and sampling techniques, data collection instruments, validation and reliability of the instruments, ethical considerations and finally the methods of data analysis.

3.2 Research Design

The study adopted a correlational survey design. A correlation design is useful in describing the degree of relationships among naturally occurring variables in quantitative terms without attempting to manipulate them (Mugenda & Mugenda, 1999; Cohen, Manion & Morrison, 2000; Nworgu, 2006; Fraenkel & Wallen, 2008). Relative to the present study, a correlation was used to determine if a relationship exists between perception of Biology learning environment and achievement, motivation and attitude towards Biology using correlation coefficients and multiple regression analyses. A survey provides the information that describes existing phenomena or status of two or more variables (Mugenda & Mugenda, 1999; Gall, Borg & Gall, 2003; Fraenkel & Wallen, 2008). Relative to the present study, a survey was useful in describing how students perceive the Biology learning environment, their motivation and attitude towards the subject using questionnaires and interviews. A survey design is also preferred because it is more economical because it makes possible for many subjects to be studied at the same time (Mitchel & Jolley, 2004; Fraenkel & Wallen, 2008).

3.3 Study Area

The study was conducted in sub-county public co-educational secondary schools in Siaya County, Kenya. Sub-county co-educational schools were chosen because gender difference in perception was one of the objectives of this study. Siaya County boarders Busia County to the north, Kakamega County and Vihiga County to the north east and Kisumu County to the south east and a water boarder with Homa Bay County to the South (ROK, 2010).The total area of Siaya County is approximately 2539 km^2.The County lies between latitude 0º 26' to 18' north and longitude 33º 58' East and 34º 33' West. Siaya County map is attached as appendix F on page 178. Although the County has many development initiatives, poverty is still a major challenge in the area at 35.3%. (RoK, 2010). The county has a large number of co-educational secondary schools.

3.4 Population

In this study, the population comprised 7900 (4450 boys and 3450 girls) form two students in sub-county co-educational public secondary schools in Siaya County. These are distributed in 100 secondary schools. Fifty schools were identified as high achieving and the other 50 as low achieving based on their achievement trend in Biology between the years 2010 to 2012 and having a comparable number of boys and girls. Middle achieving schools were left out in the process of determination of population for two reasons. First, some did not have the three-year trend of middle performance. Secondly, some did not have a comparable number of boys and girls. All the students take Biology as a compulsory subject up to form two. Form two students were the respondents in this study since this is the point where students opt to pursue Biology in the future or not

(KIE, 2002). It was therefore prudent to obtain their perceptions prior to another significant transition of choosing subjects to present an opportunity for future comparative expost facto studies. At this stage they have also covered reasonable content to enable them make choices. Their perceptions, level of achievement, motivation and attitude are therefore pertinent at this stage. Students in coeducational public secondary schools were sampled because compared to the single gendered schools in Siaya County, they perform poorly. Gender was identified as a possible extraneous variable from previous studies of learning environments. To control for the possible confounding effects of gender, it was included in the study (Mugenda & Mugenda, 1999).

3.5 Sample Size and Sampling procedure

The sample size comprised 815 (466 boys and 349 girls) form 2 students in coeducational public secondary schools. This represented 10.31% of the population. For descriptive studies, 10% of the population is enough to provide a representative sample when the target population is in thousands (Gay & Airasian, 2000; Mugenda & Mugenda, 1999). This provided a representative sample of the population.

A list of 50 high achieving and 50 low achieving co-educational secondary schools in Biology from 2010- 2012 in Siaya County were used as the sampling frame. From the population, the desired sample size was 790. According to the Ministry of Education policy of 45 students per a class (MOE, 2012), it would require the sample to exist in 790/45 classes (Approximately 18 classes). Multistage cluster sampling was therefore used to randomly select clusters of 18(9 from each category) form two classes from the high and low achieving co-educational secondary schools in Siaya County. Two classes each were selected from Gem, Siaya and Bondo sub-counties and one each from ugenya, Ugunja and Rarieda sub-counties from high achieving schools. Two classes each selected from Ugenya, Ugunja and Rarieda and one each from Gem, Siaya and Bondo sub-counties were from low achieving schools. In schools that had more than one stream, simple random sampling was used to select the stream that participated in the study. Cluster sampling is more feasible in selecting groups of individuals rather than individuals from a defined population (Gall, Borg & Gall, 2003). This procedure gave a sample of 399 students from high achieving schools and 416 students from low achieving schools. Of these, 466 were boys and 349 were girls. In the next stage of multistage cluster sampling, four students, 2 boys and 2 girls were randomly selected from each of the 18 classrooms for an interview. According to Fraenkel and Wallen (2008) qualitative sampling is done purposively to produce the best understanding of the phenomenon under investigation. In this study, two boys and two girls per class was deemed to adequately represent the gender requirements of the study. The interview sample therefore included 72 students. Table 2 shows the sample characteristics by school type and gender.

Table 2: Sample Characteristics by School Type and Gender

Category	Population	Sample	Percentage
High Achieving Schools	3900	399	10.23
Low Achieving Schools	4000	416	10.40
Boys	4450	466	10.47
Girls	3450	349	10.11
Overall	7900	815	10.31

3.6 Data Collection Instruments

This study used five instruments of data collection namely: Student Perception Questionnaire (SPQ), Student Achievement Test (SAT), Student Motivation Questionnaire (SMQ), Student Attitude Questionnaire (SAQ) and Student Interview Guide (SIG).

3.6.1 Student Perception Questionnaire

The Student Perception Questionnaire (SPQ) was adopted from Johnson and McClure (2004). This instrument was originally constructed to measure constructivist learning environment in science in general, however the items were reworded to reflect Biology learning and also made more personalized to enable the students respond as individuals. The original instrument had Cronbach alpha reliability co-efficient of 0.93 and 0.94 respectively for actual and preferred respectively. It is a five point response scale coded as Almost Always- 5, Often - 4, Sometimes - 3, Less Often -2, and Almost Never - 1. The instrument consists of two forms that are 'actual' and 'preferred' forms. The actual form assesses the current learning environment of the classroom and the preferred form assesses the students' preferences about the constructivist learning environment.

The instrument had 20 items, with 5 scales (4 items on each scale). The scales are Personal relevance, uncertainty, critical voice, shared control, and student negotiation. The scale on personal relevance was concerned with the degree to which the teachers relate Biology learning to experiences outside the school or is contextual. Uncertainty was concerned with the degree to which opportunities are provided for students to experience Biological knowledge as provisional, tentative or evolving. Critical voice was concerned with the extent to which the learning environment has been created in which students feel it is acceptable and significant to question the teachers' methods of teaching to express concerns about any hindrances to their learning. Shared control was concerned with the extent to which students and teachers can co-control the Biology learning environment. Finally, Student negotiation was concerned with the degree to which the learning environment provides for cooperative learning. SPQ is attached as Appendix A on page 164.

3.6.2 Student Achievement Test

The Student Achievement Test (SAT) was developed by the researcher from the past Biology examinations from KNEC that had covered form one work. Form one work was chosen for purposes of uniformity in syllabus coverage in the sampled schools. The test covered the five topics of Introduction to Biology, Classification, The Cell, Cell physiology and Nutrition in plants and animals. The test contained 25 items of multiple choice type. Each of the items in the test had a stem and four options consisting of one correct answer and three distracters that mostly reflected the misconceptions of the students. The items tested knowledge, comprehension and application of the basic concepts in the topics. The SAT is attached as Appendix B on page 167.

3.6.3 Student Motivation Questionnaire

The Student Motivation Questionnaire (SMQ) was adopted from Tuan, Chin and Shieh (2005) and modified to suit the study by the researcher. This instrument was originally developed to measure motivation towards science in general and consisted of 35 items on a five-point likert type of scale coded as Strongly Agree -5, Agree -4, Undecided -3, Disagree -2, Strongly Disagree -1. The Cronbach alpha for the entire questionnaire was 0.89. The instrument was modified to specifically measure motivation towards Biology and the items were reworded to make the items more personalized. This instrument had 6 scales: self-efficacy with 7 items related to students' beliefs about their own ability to perform well in Biology learning tasks. Biology learning value with 8 items related to the value of Biology in daily life. Active Learning Strategies with 5 items related to students' active participation in using a variety of strategies to construct new knowledge based on their previous understanding. Performance goal with 4 items related to students' competition with other students and their desire to get attention from the teacher. Achievement Goal with 5 items related to students' satisfaction as they increase their competence and achievement during Biology learning: and Learning environment stimulation with 6 items related to learning environment factors that affect students' motivation in Biology learning.

The likert style items were specifically concerned with various aspects of Motivations of students towards Biology. The students were required to indicate whether they strongly Agree, Agree, Undecided, Disagree or Strongly Disagree with the statements. SMQ is attached as Appendix C, page 172.

3.6.4 Student Attitude Questionnaire

The Student Attitude Questionnaire (SAQ) was adopted and modified from Prokop, Tuncer and Chuda (2007). The original instrument had a Cronbach alpha value of 0.87 and was reworded to enable individualized responses to the items. Finally the instrument had 30 likert style items. The instrument was coded as Strongly Agree -5, Agree -4, Undecided -3, Disagree -2, Strongly Disagree-1.The attitude subscales that were focused on included: interest towards Biology lessons (with 7 items), students attitude on the importance of Biology for their future career (with 5 items), students attitude on the importance of Biology lessons (with 7 items), students attitude on the Biology teacher (with 3 items), students' attitude towards difficulty of Biology lessons (with 4 items), and student attitude towards use of equipment (4 items). The likert style items were specifically concerned with various aspects of attitude of students towards Biology. The students were required to indicate whether they strongly Agree, Agree, Undecided, Disagree or Strongly Disagree with the statements. SAQ is attached as Appendix D, page 175.

3.6.5 Student Interview Guide

Student Interview Guide (SIG) was developed by the researcher and used to triangulate data collected from the other three instruments i.e. SPQ, SMQ and SAQ. The questions were generated from each of the subscales of the instruments. SPQ had 5 questions, SMQ had 6 questions and SAQ had 5 questions giving a total of 16 questions. The Student Interview Guide is attached as appendix E, page 177.

3.7 Validity and Reliability of Instruments

The instruments SPQ, SAT, SMQ, SAQ and SIG were subjected to validation before piloting. After piloting of the instruments in schools with the same characteristics as the sample, the results were subjected to reliability tests.

3.7.1 Validation of Instruments

According to Mugenda and Mugenda (1999), Validity is the degree to which results obtained from analysis of data actually represent the phenomenon under study. To achieve construct and content validities of SPQ, SAT, SMQ, SAQ and SIG, the instruments were presented to experts in science education in the school of education for examination and recommendation. This allowed for the checking of the appropriateness of the language used so that students were able to comprehend them. It also allowed for the rewording of items perceived to be ambiguous and checking of the items to ensure they measured what they purported to measure.

3.7.2 Reliability of Instruments

Reliability is a measure of the degree to which a research instrument yields consistent results or data after repeated trials (Mugenda & Mugenda ,1999). The SPQ, SAT, SMQ, SAQ and SIG were pilot-tested in two form 2 classes with 43 and 46 students from high and low achieving schools in Gem and Ugunja sub-counties respectively. The form 2 classes (with 50 boys and 39 girls) did not take part in the study. Rewording of SIG items was done based on the findings from piloting. The Cronbach's Correlation Coefficient alpha (α) formula was used to test for the reliabilities of SPQ, SAT, SMQ, and SAQ. Cronbach's correlation coefficient alpha is considered useful in determination of internal consistency of tests and questionnaires (Anastasi, 1982 Mugenda & Mugenda, 1999). A reliability coefficient of 0.7 and above was acceptable (Ebel, 1972; Ogunniyi, 1992; Gall et al, 2003). Table 3 shows the overall instrument reliabilities of SPQ (actual and preferred), SAT, SMQ and SAQ.

Table 3: Reliabilities of Research Instruments

Instrument	Number of items	Chronbach's alpha
Student Perception Questionnaire (SPQ)		
Actual Form	20	0.823
Preferred Form	20	0.855
Student Achievement Test (SAT)	25	0.794
Student Motivation Questionnaire (SMQ)	35	0.875
Student Attitude Questionnaire (SAQ)	30	0.784

3.8 Data Collection Procedures

The researcher sought for research permit from Siaya County Education office through the School of Post Graduate Studies (SGS) of Maseno University (this is attached on page 179).The researcher then requested an introductory letter authorizing the researcher to visit the schools involved in the study and to inform the head teachers of the intended study. On entry to the schools the researcher sought audience with the Heads of science department who in turn arranged for a meeting with the Biology teachers concerned.

Appointments were thereafter made for the administration of instruments. The SAT was administered to students before SPQ, SAQ, SMQ and SIG.

3.9 Ethical Considerations

During this study, the following ethical issues were considered: The respondents were informed that the information that they provide was going to be kept with confidentiality; the identity and privacy of the respondents was protected by use of numbers to label the respondents and not names; informed consent of the respondents was sought from the school authorities and students themselves before engaging them in the study.

3.10 Methods of Data Analysis

Both quantitative and qualitative methods were used in data analysis. The data collected using questionnaires were grouped, organized and categorized according to specific objectives and the research objectives.

The quantitative data generated from SAT were scored according to the scheme that was prepared earlier. The student score was the sum of correct responses out of 25, hence the scores ranged varied from 0 to 25. The data generated from SPQ, SMQ and SAQ were computed according to the scales of each instrument. The scores for each respondent per scale were computed by taking the mean of the items that make up the scale, summations were thereafter made to find the overall score for each student for the overall instrument. SPQ, SMQ and SAQ were analyzed using both descriptive and inferential statistics.

The qualitative data collected using SIG were grouped according to their similarity in content then coded manually in relation to the subscales of the instruments SPQ, SMQ and SAQ. This was done in this manner because the content of the interview guide was developed from the questionnaires. They were also organized in relation to research objectives. Analysis was done deductively using the framework of the subscales of the questionnaires.

Quantitative data were analyzed using Statistical Package for Social Sciences (SPSS). Descriptive statistics were used to summarize quantitative data. Inferential statistics were used to test hypotheses. All the tests were accepted at a significance level of $\alpha=0.05$. To determine the perception of the learners on the Biology learning environment and the gender differences in perception of the learning environment, paired sample t-tests, independent sample t-tests were used. To determine the relationship between the perception of the Biology learning environment and achievement, motivation and attitude, Pearson Correlation Analyses and Multiple Regression Analyses were used. Table 4 gives a summary of the methods of that were used in data analysis.

Table 4: Summary of Data Analysis Procedures

Research Hypotheses	**Independent variable**	**Dependent variable**	**Test statistics**
$H_0$1: There is no significant difference between students' perception of actual and preferred learning environment.	Constructivist Learning Environment , Actual Learning Environment	Perception	Paired sample t-tests, Independent sample t-tests
$H_0$2: There is no significant relationship between students' perception of Biology learning environment and achievement.	Biology Learning Environment	Achievement	Pearson Correlation Analysis, Multiple Regression Analysis
$H_0$3: There is no significant relationship between students' perception of Biology learning environment and motivation towards Biology.	Biology Learning Environment	Motivation of students	Pearson Correlation Analysis, Multiple Regression Analysis
$H_0$4: There is no significant relationship between students' perception of Biology learning environment and attitude towards Biology.	Biology Learning Environment	Attitude of students	Pearson Correlation Analysis Multiple Regression Analysis
H_0 5: There is no significant gender difference in perception of Biology learning environment.	Biology Learning Environment	Perception of Boys and Girls	Independent sample t-tests

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

In this chapter, the results and discussions of the study on relationship between students' perception of Biology learning environment and their Achievement, motivation and attitude in co-educational secondary schools in Siaya County have been presented. Descriptive statistics have been used to present the findings of the study. The inferential statistics have been used to test hypotheses of the study. Qualitative data have been used to explain inferential statistics. The presentation has been done according to the study objectives. It begins with perception of Biology learning environment, relationship between students' perception of the Biology learning environment and achievement, relationship between perception of learning environment and motivation, relationship between students' perception of learning environment and attitude, and finally ends with gender differences in perception of learning environment.

4.2 Perception of Biology Learning Environment

To test the hypothesis that 'there is no significant difference between students' perception of actual and preferred learning environment' paired t-tests and independent sample t-tests were performed. Qualitative data are also used to discuss inferential statistics. Table 5 shows the descriptive statistics and the paired sample t-tests of how the students in high achieving schools perceive their actual and preferred learning environments as assessed by SPQ.

Table 5: Perceptions of Actual and Preferred Learning Environment by HAS

	Actual (A)		**Preferred (P)**		**N = 399**	
SPQ Scales	**Mean**	**SD**	**Mean**	**SD**	**(P-A)**	***t*-value**
Personal Relevance	2.266	0.449	3.830	0.528	1.565	47.902*
Uncertainty	2.271	0.356	3.765	0.523	1.494	49.339*
Critical Voice	2.184	0.337	3.681	0.634	1.497	42.318*
Shared Control	2.109	0.313	3.917	0.441	1.811	69.786*
Student Negotiation	2.430	0.481	3.859	0.487	1.430	41.789*

Key: *$p < 0.05$, **SPQ** = Student Perception Questionnaire

From Table 5 it can be seen that students in high achieving schools perceive their actual learning environment as not offering enough opportunities for them to relate Biology to their context of learning (*M* = 2.66), experience the provisional status of biological knowledge (*M* = 2.271), question pedagogical strategies in Biology learning freely (*M* = 2.184), co-control Biology learning environment (*M* = 2.109) and not providing for cooperative learning (*M* = 2.430). On the other hand the students have a high preference for Biology learning environment that relates Biology to the context of learning (*M* = 3.830); where they experience the evolution and provisional status of biological knowledge (*M* = 3.765); where they question the methods of teaching Biology freely (*M* =3.680); where they co-control Biology learning process with the teacher (*M* = 3.917) and which provides for cooperative learning (*M* = 3.859).

Considering the responses of the students from high achieving schools as regards the actual Biology learning environment, they had the highest mean score for student negotiation indicating some level of social interaction taking place but still below par. The lowest mean score was on shared control. Ozkal et al (2009) found the highest mean score for the scale of personal relevance among grade eight students while Kwan & Wong (2014) found the highest mean score for uncertainty among secondary school students. In general there seem to be a domination of the teacher in the learning environments with minimal emphasis on the relevance of Biology to everyday life (Moustafa, et al, 2013). There was little emphasis of the evolution of biological knowledge; there are minimal opportunities for the learners to question the pedagogical plans of the teacher, little chances to co-control the Biology learning environment and for collaborative learning to take place (Choo, 2011).

Considering their responses to the preferred form of SPQ, the highest mean score was observed for shared control, indicating that students prefer to co-control the learning environment. The lowest was critical voice. In general, the respondents' scores on the preferred form were higher than those of the actual form. The paired t-tests also revealed that there existed statistically significant differences in perception between actual and preferred learning environment in all the five subscales of SPQ at $\alpha = 0.05$ for students in high achieving schools in favor of preferred learning environment. They perceived that their actual Biology learning environment did not provide enough opportunities for personal relevance, uncertainty, critical voice, shared control and student negotiation. These findings show that a majority of the respondents from high achieving schools perceived that the actual learning environment as not matching their preferences. The following excerpt shows a summary of most of the views of students from High achieving schools as regards the actual learning environment.

HAS_1 *'Sometimes new learning relates what is outside to what we learn in books. Some of the biological explanations have changed over time like the source of vitamin D. It is not proper to question how the teacher is teaching as this can be misunderstood. Helping the teacher to plan is not easy because I also have a lot to do on my own'*

The excerpt above shows that the actual learning environment as perceived by the students does not provide for a constructivist learning environment. However there are moments when the students experience the learning environment as providing for personal relevance. There are times when they experience biological knowledge as ever changing. However this does not appear to be a common phenomenon. The learners observe that critical voice is lacking in the learning environment hence they are not able to question the pedagogical plans of the teacher (Moustafa et al, 2013). The teachers seem to be the focal point in the learning environments (Gregory, 2013). The curriculum burden appears to be a reality that prevents the teachers and learners from co-controlling the learning environment (Koul & Fisher, 2003; Ying, 2008). Table 6 shows the descriptive statistics and the paired sample t-tests of how the low achieving students perceive their actual and preferred learning environments as assessed by SPQ.

Table 6: Perceptions of Actual and Preferred Learning Environment by LAS

	Actual (A)		**Preferred (P)**		**N = 416**	
SPQ Scales	**Mean**	**SD**	**Mean**	**SD**	**(P-A)**	***t*-value**
Personal Relevance	2.099	0.185	4.164	0.376	2.065	99.320*
Uncertainty	2.204	0.214	4.151	0.393	1.947	92.672*
Critical Voice	2.205	0.205	4.212	0.423	2.007	88.479*
Shared Control	2.100	0.288	4.203	0.343	2.103	108.64*
Student Negotiation	2.138	0.278	4.187	0.412	2.050	88.062*

Key: *$p < 0.05$, **SPQ** = Student Perception Questionnaire

From Table 6 it can be seen that students in low achieving schools perceive their actual learning environment as not offering enough opportunities for them to relate Biology to their context of learning (*M* = 2.099), experience the provisional status of biological knowledge (*M* = 2.204), question pedagogical strategies in Biology learning freely (*M* = 2.205), co-control Biology learning environment (*M* = 2.100) and not providing for cooperative learning (*M* = 2.137). On the other hand the students have a high preference for Biology learning environment that relates Biology to the context of learning (*M* = 4.164); where they experience the evolution and provisional status of biological knowledge (*M* = 4.151); where they question the methods of teaching Biology freely (*M* =4.212); where they co-control Biology learning process with the teacher (*M* = 4.203) and which provides for cooperative learning (*M* = 4.187). The paired t-tests revealed that there existed a statistically significant difference in perception between actual and preferred learning environment in all the five subscales of SPQ at $\alpha = 0.05$ for the students in low achieving schools in favor of preferred learning environment.

The students from low achieving schools perceived their actual learning environment as not providing them with opportunities to relate Biology learning to everyday life (Moustafa et al, 2013), experience provisional status of biological knowledge, question the pedagogical plans of the teacher, co-control the Biology learning environment and experience collaborative learning (Ozkal et al, 2009). This indicates that the teachers tend to see the students on the receiving end of the instructional process (Beyhan, 2013). The following excerpt is a summary of students' perspective of the actual learning environment from Low achieving schools.

LAS$_1$ *"How can I question the teaching method of the teacher? The teacher knows the subject and we are just students. You can be in trouble if you question the teacher. Again the questioning the teacher wastes time because we have to clear the syllabus. It is the teacher who knows what to teach. How would we know that biology has changed? I would like to help the teacher to plan, but will the teacher agree? There is no way we as students can help the teacher to plan for lessons".*

The excerpt above shows that the curriculum could be playing a major role on the perception of the Biology learning environment created in the county. According to Koul and Fisher (2003), the nature of the curriculum could exert a negative influence on the kind of learning environment that is created. The learning environment was mainly transmissive where the students play a rather inactive role. In such learning environments, knowledge is treated as a 'commodity' to be delivered from the teacher to the students without much feedback from the students (Ying, 2008).This is due to an examination oriented curriculum where the teachers have the responsibility to complete the syllabus within a given timeframe to excel in examinations. The students were not aware that biological explanations have evolved over time (Ozkal, 2007). There was no way for them to know whether explanations have changed. The indication is that the teachers merely explain the objective reality as presented in the textbooks and fail to integrate the changes that have occurred into perspective or letting the learners know the tentative nature of biological explanations (Taskin-can, 2013). The students did not think that they can question the teachers' pedagogical plans due to the trust that they had on the teacher. On the other hand it was likely to be considered as indiscipline in the school environment (Ozkal et al, 2009). On the other hand, it appears the students subscribe to the custodial student control ideology where the teacher is ultimate authority and source of knowledge (Beyhan, 2013; Gregory, 2013).The students had little time to negotiate meanings of the concepts they were experiencing in the learning environment. A situation of inter-subjectivity of social meanings was lacking (Orey, 2010). However they would prefer a situation where they have time to discuss on their own and also consult the teacher.

It was also necessary to carry out independent sample t-tests to find out whether there were differences in perception of the actual learning environment between the low and high achieving schools. Table 7 shows Levene's test for equality of variances and t-test for equality of means. Levene's tests for each of the subscales produced significant results except for shared control hence t-test analyses for the rest of the sub-scales are based on equal variances not assumed.

Table 7: Independent Sample t-tests for ALE for HAS and LAS

Group 1= HAS, N = 399; Group 2 = LAS, N = 416							
	Levene's tests		**The t-tests**				
SPQ Scales	*F*	Sig	*t*	df	*p*	MD	SEM
Personal Relevance	112.876	0.000	6.860	524.637	0.000	0.1665	.02427
Uncertainty	30.165	0.000	3.204	648.165	0.001	0.0664	.02071
Critical Voice	38.947	0.000	-1.116	651.015	0.265	-.0219	.01966
Shared Control	0.227	0.634	0.442	813	0.659	0.0093	.02103
Student Negotiation	56.597	0.000	10.544	631.916	0.000	0.2916	.02765

p*< 0.05 Key: **SEM = Standard Error Mean, **HAS** = High Achieving Schools, **LAS** = Low Achieving Schools **ALE =** Actual Learning Environment **MD** =Mean Difference

Table 7 indicates that the preference levels of students in high achieving schools are higher for the scales of personal relevance, uncertainty, shared control and student negotiation as depicted by the mean differences. At the same time, there existed statistically significant differences between students in high and low achieving schools in favor of students in high achieving schools in terms of personal relevance, uncertainty and student negotiation. There were no statistically significant differences in perception of the actual learning environment for the subscale of critical voice and shared control.

This indicates that the students in high achieving schools perceive their actual Biology learning environment more favorably compared to their low achieving counterparts in terms of personal relevance, uncertainty and student negotiation. Rita and Martin-Dunlop (2011) have noted that students who score higher on achievement tests are more likely to attribute this to the nature of the learning environment hence the high scores in the actual learning environment by students in high achieving schools. On the other hand, the students in high achieving schools and low achieving schools perceive their actual learning environment more or less the same in terms of critical voice and shared control. This indicates that the prevailing learning environment is dominated by the custodial student control ideology (Beyhan, 2013) where the students have no opportunity to question the pedagogical plans of the teacher and the teacher plans and executes the instructional goals.

Independent sample t-tests were also carried out to find out whether there were differences in perception of the preferred learning environment between the low and high achieving schools. This is shown in Table 8.

Table 8: Independent Sample t-tests of PLE for HAS and LAS

	Group 1= HAS, N = 399; Group 2 = LAS, N = 416						
	Levene's tests		**The t-tests**				
SPQ Scales	*F*	Sig	*t*	df	*p*	MD	SEM
Personal Relevance	75.314	0.000	-10.362	716.561	0.000	-.3338	.03222
Uncertainty	48.245	0.000	-11.881	737.845	0.000	-.3864	.03252
Critical Voice	184.794	0.000	-13.936	685.970	0.000	-.5316	.03815
Shared Control	18.970	0.000	-10.304	751.642	0.000	-.2858	.02714
Student Negotiation	8.908	0.003	-10.364	778.570	0.000	-.3278	.03164

*p< 0.05 Key: **SEM** = Standard Error of Mean, **HAS** = High Achieving Schools, **LAS** = Low Achieving Schools, **PLE** = Preferred Learning Environment **MD** = Mean Difference

Table 8 shows Levene's test for equality of variances and t-test for equality of means. Levene's tests for each of the subscales produced significant results hence t-test analyses for all the sub-scales are based on equal variances not assumed. Table 8 indicates that the preference levels for Biology constructivist learning environment are higher among the students in low achieving schools than the high achieving schools for all the scales of SPQ as depicted by the negative values of the mean differences and negative t-values. At the same time, there existed a statistically significant difference between the students in low achieving schools and high achieving schools in favor of the low achieving schools at an alpha level of 0.05.

The findings in Table 8 indicate that the students in low achieving schools have high preference levels for a constructivist learning environment compared to the students in the high achieving schools. This could be due to the fact that the students in the high achieving schools score higher in Biology achievement tests and therefore naturally attribute this to a favorable learning environment (Rita & Martin-Dulop, 2011). The low achieving students are likely to attribute their low scores on the extrinsic factors like the nature of the learning environment. They seem to have an external locus of causality (Palmer, 2005).This might have led to high preference levels for a constructivist learning environment. The qualitative data are in support of the findings from the quantitative data. The excerpt below shows the views of students from low and high achieving schools.

LAS_1: "*I would prefer a biology learning environment where we can always relate what we learn in class with what is outside in real life situation"*
HAS_1: *"I would prefer the Biology learning environment to be compared to what is out there in reality but that always happens"*

The students generally have high preferences for constructivist learning environment. However the views of students from low achieving schools seem to be stronger. They have strong views in which they expect the learning environment to relate what happens in the learning environment with what is outside in the real life situation (Ozkal et al, 2009). They expect a school Biology that is not disconnected from their own lives (UNESCO, 2010). Relevance of the subject can be established by doing practical experiments, developing theories from the process of inquiry rather than using theory to explain phenomena (Kember et al, 2010). The excerpt below shows the views of students on questioning the pedagogical plans of the teacher.

LAS_1 "*Some teachers do not teach us well so we need to tell them that the method they using do not help us"*

HAS$_1$ *"The teachers should do their job of teaching because they are trained to do it"*

On whether they should question the pedagogical plans of the teacher, the students from low achieving schools have strong feelings that they should have a say. They feel they should express their thoughts and criticize the teaching strategies (Ozkal et al, 2009). This could be due to the fact that they attribute their failure or good performance to the extrinsic factors like what the learning environment provides (Otami et al, 2012). The students from high achieving schools view teaching as the teacher's domain and should remain as such. This indicates that the students in high achieving schools do not perceive the teacher as a hindrance to their conception of Biology concepts. The following excerpts show students views on the provisional status of biological knowledge.

LAS$_1$ "*Science remains the same as it was long time ago. The method of teaching is what keeps changing".*

HAS$_1$*"Biology explanations keep changing. For example in primary school we were taught that the sun is the source of vitamin D, but now it has been found that it is made in the skin".*

On whether biological knowledge has changed over time, the students from high achieving schools seem to have the view that biological knowledge keeps changing. This seems to stem from the fact that certain misconceptions that they held previously in primary school have been clarified like 'the source of Vitamin D'. They have tentative scientific epistemological beliefs (Ozkal, 2007). The students from high achieving schools find it easy to unify their previous knowledge and experiences with new knowledge (Moustafa et al, 2013). This is meant to establish consonance and dissonance (Trna, 2014).The students from low achieving schools seem unaware that scientific knowledge is tentative and provisional. According to Ozkal (2007) such students hold fixed views of scientific epistemological beliefs.

The findings from this study generally relate with earlier learning environment research that students' generally prefer a more favorable learning environment compared to the actual one they are currently experiencing (Kim et al, 1999; Ozkal et al, 2009; Rita & Martin-Dunlop, 2011; Yang, 2013). Specifically in this study, the students in both high and low achieving schools tended to prefer a more constructivist learning environment which gives them more opportunities to relate Biology to their context of learning; enables them to experience the evolution and provisional status of biological knowledge, offers them chance to question pedagogical strategies in Biology learning freely, gives them opportunity to co-control the Biology learning environment with the teacher and finally a learning environment that provides for cooperative and collaborative learning.

The findings from this study also imply that the students in high achieving schools perceive their actual learning environment more favorably compared to their low achieving peers. On the other hand, the students in low achieving schools have high preference levels for a constructivist learning environment compared to their high achieving peers. The students in low achieving schools have a greater person-environment fit variance than the students in the high achieving schools in terms of preferred learning environment.

4.3 Perception of Learning Environment and Achievement

To test the null hypothesis that there is no significant relationship between students' perception of learning environment and achievement in high and low achieving schools, descriptive statistics are first presented followed by Pearson Correlation Analyses and lastly Multiple Regression Analyses. Assumptions of normality, homoscedasticity, linearity and independence were met prior to Multiple Regression Analysis. To detect multicollinearity among the independent variables, correlation matrices, Tolerance and Variance Inflation factor were used. Table 9 represents the descriptive statistics.

Table 9: Descriptive Statistics for SAT and SPQ- Preferred form

	HAS, N = 399; LAS, N = 416		
School Type	**Variable**	**Mean**	***SD***
High Achieving schools	SAT	15.82	2.354
(**HAS**)	Personal Relevance	3.830	0.527
	Uncertainty	3.765	0.523
	Critical Voice	3.680	0.639
	Shared Control	3.917	0.440
	Student Negotiation	3.859	0.487
Low Achieving Schools	SAT	12.40	2.363
(**LAS**)	Personal Relevance	4.164	0.375
	Uncertainty	4.151	0.393
	Critical Voice	4.212	0.423
	Shared Control	4.203	0.343
	Student Negotiation	4.187	0.410

Key: SAT=Student Achievement Test, **SPQ** = Student Perception Questionnaire

Table 9 indicates that the mean scores of the students in SAT in high achieving schools is higher (*M* = 15.82, *SD* = 2.354) compared to that of low achieving schools (*M* = 12.40, *SD*

= 2.363). The mean scores of the students in the preferred form of SPQ in both the two school types are above the average in all the subscales but higher among the low achieving schools. The results in Table 9 indicate that the students in both high and low achieving schools prefer a learning environment that provides for personal relevance, that presents biological knowledge as tentative, where the learners can question the pedagogical approaches of the teacher, take an active role in planning, conducting and assessing Biology learning and be involved with other students in negotiating viability of new ideas in Biology classroom (Arisoy, 2007). The high preference levels for a constructivist learning environment could also be a pointer to the fact that the prevailing learning environment in Biology classrooms was likely to be characterized by direct transmission where the student is on the receiving end of the instructional process (Beyhan, 2013). Such learning environments are characterized by teacher demonstration of the 'correct' way of solving problems, no discussions and are built around the quantity of background knowledge (OECD, 2009). Table 10 shows the Pearson's correlation coefficients between SAT scores and the scores on subscales of SPQ-actual form among the high achieving schools and low achieving schools.

Table 10: Correlations between ALE and SAT among HAS and LAS

	High Achieving Schools		Low Achieving Schools	
Variable	**SAT**	***p*-Value**	**SAT**	***p*-value**
Personal Relevance	0.157*	0.014	0.180*	0.004
Uncertainty	0.117*	0.019	0.134*	0.012
Critical Voice	0.145*	0.002	0.169*	0.001
Shared Control	0.101*	0.043	0.129*	0.040
Student Negotiation	0.128*	0.010	0.144*	0.030

***** $p < 0.05$ (2-tailed) **HAS** = High Achieving Schools; **LAS** = Low Achieving Schools **SAT** = Student Achievement Test **SPQ**= Student Perception Questionnaire

Table 10 indicates that the correlations between SAT and students' perceptions of the actual learning environment in high achieving schools were positively statistically significant at an alpha level of 0.05. The smallest relationship was r (399) = .101, p = 0.043 between SAT and shared control scale. The largest relationship was r (399) = .157, p = 0.014 between SAT and personal relevance. Table 10 also indicates that correlations between SAT and subscales of SPQ-actual form were positively statistically significant at .05 level (2-tailed) among the students in the low achieving schools. The smallest relationship was r (416) = .129, p = 0.040 between SAT and shared control scale. The largest relationship was r (416) = .180, p = 0.004 between SAT and personal relevance.

Table 10 indicate that the correlations between the scores of SAT and SPQ-actual form among students in high and low achieving schools are statistically significant however, they are weak. The low r values may not be of statistical significance but could be of practical significance (Mugenda & Mugenda, 1999; Gall, Borg & Gall, 2003; Fraenkel &

Wallen, 2008). Table 11 shows the correlations between SAT and the subscales of SPQ-preferred among students in High achieving schools and low achieving schools.

Table 11: Correlations between PLE and SAT among HAS and LAS

	High Achieving Schools		Low Achieving Schools	
Variable	**SAT**	***p*-Value**	**SAT**	***p*-value**
Personal Relevance	0.157*	0.034	0.177*	0.036
Uncertainty	0.103*	0.018	0.119*	0.032
Critical Voice	0.085	0.062	0.090	0.081
Shared Control	0.101	0.073	0.112*	0.012
Student Negotiation	0.128*	0.040	0.153*	0.022

***** $p < 0.05$ (2-tailed) **HAS** = High Achieving Schools; **LAS** = Low Achieving Schools **SAT** = Student Achievement Test **SPQ**= Student Perception Questionnaire,

Table 11 indicates that only the correlations between SAT and the subscales of personal relevance(r = .157, p < .05), Uncertainty (r = .103, p < .05) and student negotiation (r =.128, p < .05) were statistically significant at the alpha level of 0.05 among the students in high achieving schools. The rest of the correlations between SAT and the other subscales of the actual learning environment were not statistically significant. However the r values from the high achieving schools were lower than those of the low achieving schools. On the other hand the correlations between SAT and the subscales of personal relevance(r = .177, p < .05), uncertainty (r = .119, p <.05), shared control (r = .112, p < .05) and student negotiation (r = .153, p < .05) among the students in low achieving schools were statistically significant.

The statistically significant correlations indicate that there exists a relationship between the preferred learning environment and the achievement in Biology. A comparison of the correlations of preferred learning environment and actual learning environment shows that those of the actual learning environment are higher. This shows that the achievement was realized in a learning environment that correlates strongly with the actual learning environment (Barzide et al, 2012). The findings also indicate that there is no significant relationship between shared control and critical voice and the achievement among the students in high achieving schools. This indicates that the learning environment does not allow for the students to co-control the learning environment with the teacher. According to Martinez and Snider (2006) high achieving students have high level of self confidence and a high degree of independence. This is likely to make them to be content with situations where they don't 'bother' the teachers and their methods of teaching. On the other hand, there is no significant relationship between critical voice and the achievement among the students in low achieving schools. They seem to value the 'authority' structure within the classroom due to the support that they derive from the classroom. In this regard, they would not question the pedagogical strategies (Koul & Fisher, 2003).

It was also necessary to examine the relationships between students' perceptions of the actual learning environment variables and their achievement in Biology using Multiple Regression Analyses. This was done to find out the relative contribution of the perception of actual learning environment to the variance in achievement and the proportion of variance in achievement explained by the actual learning environment variables in high and low achieving schools. Two multiple regression analyses on the SPQ subscales and dependent variable (Student Achievement Test) were conducted. Table 12 reports the results of the two regression analyses on the SPQ subscales and the dependent variable (SAT).

Table 12: Multiple Regression Analyses on SAT and ALE by School Type

	Model 1-HAS, N = 399			**Model 2-LAS, N = 416**		
	R^2	*F*	*p*	R^2	*F*	*p*
	0.068	2.394	0.047	0.145	13.726	0.000
Variable	Beta	*t*	*p*	Beta	*t*	*p*
Personal Relevance	.132	.344	.035	3.414	4.276	.000
Uncertainty	.069	2.025	.044	.174	2.300	.039
Critical Voice	-.050	-.166	.907	-2.090	-2.743	.042
Shared Control	-.007	-.237	.813	1.92	-6.448	.059
Student Negotiation	.170	-1.960	.050	.198	2.074	.039

Key: Predictors: Personal relevance, uncertainty, critical voice, shared control and student negotiation, **HAS** = High Achieving Schools, **LAS** = Low Achieving Schools
Dependent variable: Student Achievement Test (SAT).

The first multiple regression model with all the five predictors explained 6.8% of the variance in the high achieving schools' scores in SAT (R^2 = 0.068), *F* (5, 393) = 2.394, *p* > .05. The SAT scores of the students in high achieving schools were statistically significantly related with personal relevance, uncertainty, and student negotiation variables of the learning environment. Critical voice and shared control subscales did not have effect on student achievement in Biology as depicted by the standardized (beta) coefficient of the model. This shows that the achievement in Biology by the students in high achieving schools was not contributed by these elements of the constructivist learning environment. The second multiple regression model with all five predictors produced 14.5% of the variance in the Biology achievement scores of students from low achieving schools (R^2 = 0.145), *F* (5, 410) = 13.726, *p* < .05. Critical voice and shared control subscales did not have effect on student achievement in Biology as depicted by the standardized (beta) coefficient of the model. This could be indicative of the fact that these elements of constructivist learning environment are lacking in the actual learning environment of the low achieving schools. It also indicates that the achievement was not realized in a constructivist learning environment. The findings from the two multiple regression analyses indicate the existence of a nexus between learning environment and achievement (Tran, 2013). It is notable that the actual learning environment contributed to a higher variance in student achievement in low achieving schools than the high achieving schools. The explanation could be attributed to other factors contributing to the achievement of high achieving schools in Biology other than the learning environment only. Personal relevance and student negotiation are the best predictors of achievement in Biology. It appears that the actual learning environment of low achieving schools made Biology learning more relevant to their daily lives and there was an element of interaction between the learners.

It was also necessary to examine the relationships between students' perceptions of the preferred learning environment and their achievement in Biology using Multiple Regression Analyses. This was done to find out the relative contribution of the perception of preferred learning environment to the variance in achievement and the proportion of variance in achievement explained by the preferred (Constructivist) learning environment variables in high and low achieving schools. Two multiple regression analyses on the SPQ subscales and dependent variable (Student Achievement Test) were conducted. Table 13 reports the results of the two regression analyses on the SPQ subscales and the dependent variable (SAT).

Table 13: Multiple Regression Analyses on SAT and PLE by School Type

	Model 1-HAS, N = 399			**Model 2-LAS, N = 416**		
	R^2	*F*	*p*	R^2	*F*	*p*
	0.028	2.270	0.047	0.065	5.667	0.000
Variable	Beta	*t*	*p*	Beta	*t*	*p*
Personal Relevance	.094	.635	.002	.066	.927	.042
Uncertainty	.049	.562	.005	-.194	-2.886	.004
Critical Voice	-.121	-1.331	.006	.242	4.038	.000
Shared Control	.013	.191	.849	.011	.166	.058
Student Negotiation	-.063	-.854	.009	.240	3.794	.000

Key: Predictors: Personal relevance, uncertainty, critical voice, shared control and student negotiation, **HAS** = High Achieving Schools, **LAS** = Low Achieving Schools
Dependent variable: Student Achievement Test (SAT).

The first multiple regression model with all the five predictors explained 2.8% of the variance in the high achieving schools' scores in SAT (R^2 = 0.028), F (5, 393) = 2.270, $p < .05$. The SAT scores of the students in high achieving schools were statistically significantly related with personal relevance and uncertainty variables of the learning environment. The achievement scores of SAT among high achieving schools were primarily predicted by lower levels of critical voice and student negotiation as depicted by the standardized (beta) coefficients of the model. Shared control did not predict the achievement of students in Biology. This means that the achievement is not contributed to a large extent by a constructivist learning environment. The second multiple regression model with all five predictors produced 6.5% of the variance in the Biology achievement scores of students from low achieving schools (R^2 = 0.065), F (5, 410) = 5.667, $p < .05$.

The achievement scores of SAT were primarily predicted by lower levels of personal relevance, critical voice and student negotiation as depicted by the standardized (beta) coefficients of the model. The achievement was predicted by lower levels of critical voice. Shared control did not significantly predict the achievement of students in low achieving students.

The findings in Table 13 indicate that when the learning environment of the high achieving schools provides for personal relevance then their achievement is contributed to significantly. This means that when the learning environment establishes the relevance of what is being taught by relating theory to practical applications, to local examples, and to every day applications, then they are likely to achieve better (Kember et al, 2010). On the other hand the learning environment needs to portray the provisional status of Biological knowledge. This would happen by focusing on the conceptual development into focus when teaching different biological phenomena. This would make the evolution of biological knowledge to be clearer (Ozkal et al, 2009). The achievement is also predicted by lower levels of critical voice. This indicates that the students in high achieving schools would not wish to question the pedagogical plans of the teacher. In learning environments characterized by transmission approaches, questioning the teachers' pedagogical strategies can be misinterpreted to lack of respect (Koul & Fisher, 2003; Ozkal et al, 2009). On the other hand the high achieving students have a high ability to abstract concepts and good problem solving ability (Martinez & Snider, 2006). In this regard, the students in the high achieving schools may not be concerned about the significance of questioning the pedagogical plans of the teacher.

On the other hand, among the students in low achieving schools, their achievement was predicted by higher levels of personal relevance, critical voice and student negotiation and lower levels of uncertainty. The students in low achieving schools seem not to be concerned with the evolution of biological knowledge. They seem contented with the objective reality as presented in books (Taskin-can, 2013). This also indicates that they have surface strategies for cognition (Tang & Neber, 2008). Generally there was low contribution of preference for constructivist learning environment for variance in achievement in Biology in both the school types. The regression analyses also indicate that the quality of the prevailing learning environment is a determinant of the cognitive outcomes (Wahyudi & Treagust, 2004). At the same time, the multiple regression analyses indicate the potential of constructivist learning environment to improve Biology achievement. The analyses for actual and preferred learning environments emphasize the person-environment fit as a determinant factor predicting student achievement (Bas, 2012; Harris, 2013).

Despite the low variances of achievement explained by the constructivist learning environment domains among the high and low achieving students, the findings of this study have indicated that personal relevance is the strongest predictor of Biology achievement among the high achieving students in actual and preferred learning environments. This implies that Biology achievement of students from high achieving schools is contributed to strongly by perception of the learning environment as providing opportunities for learners to relate Biology to their real life. On the other hand, student negotiation is the strongest predictor of Biology achievement among the low achieving students in actual and preferred learning environments. The implication is that when the students from the low achieving schools perceive the learning environment as providing for cooperative and collaborative learning, their achievement in Biology would be contributed to strongly. The learning environment should provide for student negotiation, where there is inter-subjectivity of meanings.

4.4 Perception of Learning Environment and Motivation

To test the null hypothesis that there is no significant relationship between students' perception of learning environment and motivation towards Biology, descriptive statistics are presented first, followed by Pearson Correlation Analyses between SPQ (actual and preferred) variables and motivational variables. Multiple Regression Analyses are finally conducted to find out whether preferences for learning environment variables contribute to variance in motivation. Qualitative data are also used to discuss inferential statistics. Assumptions of normality, homoscedasticity, linearity and independence were met prior to multiple regression analysis. To detect multicollinearity among the independent variables, correlation matrices, Tolerance and Variance Inflation factor were used. Table 14 shows the descriptive statistics of motivational subscales among the low achieving schools and high achieving schools.

Table 14: Descriptive Statistics of SMQ among HAS and LAS

SMQ Sub-scales	High Achieving Schools (HAS) Mean	*SD*	Low Achieving Schools (LAS) Mean	*SD*
Self-Efficacy	4.152	.346	3.520	.287
Active Learning Strategies	4.092	.374	3.584	.310
Biology Learning Value	3.868	.366	3.623	.350
Performance Goal	2.674	.628	4.047	.308
Achievement Goal	2.748	.651	4.002	.299
Learning Environment Stimulation	3.533	.374	2.967	.310

Key: SMQ = Student Motivation Questionnaire

Table 14 indicates that students from the high achieving schools have high scores on self-efficacy, active learning strategies, Biology learning value and learning environment stimulation than students in low achieving schools. On the other hand students from low achieving schools have high scores on performance goal and achievement goal than those from high achieving schools. This indicates that the students from low achieving schools have interest in competing with fellow students (Palmer, 2005), pleasing the teacher and validating their competence (Anderman & Anderman, 2010).

The results suggest the students from high achieving schools have confidence in their ability to organize and execute a course of action to solve a biological problem or accomplish a task. They also embrace active learning strategies where they can monitor, control and regulate aspects of their cognition (Tang & Neber, 2008). Due to the effort they expend in learning, they have value for Biology learning and this makes them to naturally find the Biology learning environment stimulating. They seem to have internal locus of causality in which case they perceive causes of their success or failure to their own ability or effort (Palmer, 2005). The low achieving schools on the hand have learners who are more focused on demonstrating their competence on tasks to other students and getting attention of the Biology teacher. The low achieving students are also interested in demonstrating their ability to get good grades on Biology tests or good grades than their peers (Palmer, 2005). The students from high achieving schools value Biology learning more than the students from low achieving schools. Sevinc, Ozmen and Yigit (2011) observe that such students are more focused on acquiring problem solving competency, experiencing the inquiry activity, stimulating their thinking and finding relevance of Biology to their daily life.

Table 15 shows the inter-correlations between student perceptions of the actual learning environment as measured by SPQ- Actual form and motivation as measured by Student Motivation Questionnaire (SMQ) among the students in high achieving schools.

Table 15: Correlations between Perception of ALE and Motivation among HAS

	High Achieving Schools(HAS), N = 399				
Variables	**PR**	**U**	**CV**	**SC**	**SN**
Self-Efficacy	.141*	.224*	.107*	.223*	.145*
Active Learning Strategies	.194*	.236*	.170*	.196*	.152*
Biology Learning Value	.010	.025	.027	.106*	.051
Performance Goal	-.258	-.355	-.311	-.314	-.269
Achievement Goal	-.245	-.364	-.328	-.293	-.245
Learning Environment Stimulation	.211*	.184*	.133*	.162*	.104*

Key: ***Correlation significant α = 0.05 level (2-tailed), **PR**= Personal Relevance, **U** = Uncertainty, **CV** = Critical Voice, **SC**= Shared Control, **SN**= Student Negotiation,

Table 15 indicates that the correlations between actual learning environment (as measured by SPQ-actual) and self-efficacy, active learning strategies and learning environment stimulation are all positively statistically significant ($p < .05$). Correlations between actual learning environment and Biology learning value are all non-significant except for that with shared control which is statistically significant ($p < .05$). The correlations between performance goal and achievement goal were negative and not statistically significant.

The positive correlation statistics indicate that the actual learning environment that the students in high achieving schools are experiencing could be having some elements of constructivism in terms of personal relevance, uncertainty, critical voice, shared control and student negotiation. Brooks and Brooks (1999) have observed that most classrooms exhibit some elements of constructivism although the teachers may not be aware. Taskin-can (2013) holds that some learning environments are in a transitional state away from transmission. The existing elements of constructivist approaches enhance their self-efficacy; activates their learning strategies and stimulates their learning environment. It also indicates that when the scores on these motivational variables increase, the scores on constructivist learning environment variables also increase. On the other hand, the students from high achieving schools have low scores on performance goal and achievement goal leading to negative correlations with the constructivist learning environment variables which are relatively high. This means that these kinds of students are not concerned about competing with their colleagues and validating their competence (Anderman & Anderman, 2010). Consequently with their relatively high scores on constructivist learning environment variables and low scores on some of these motivational variables would lead to negative correlations. Table 16 shows the correlations between the actual learning environment as measured by SPQ-actual and student motivation as measured by SMQ among the students in low achieving schools.

Table 16: Correlations between Perception of ALE and Motivation among LAS

	Low Achieving Schools (LAS), N = 416				
Variables	**PR**	**U**	**CV**	**SC**	**SN**
Self-Efficacy	-.018	.021	-.023	.360	-.008
Active Learning Strategies	-0.164*	-.161*	-.147*	-.112*	-.163*
Biology Learning Value	-.249*	-.212*	-.204*	-.218*	-.213*
Performance Goal	.191	.028	.088	-.018	-.006
Achievement Goal	.072	.037	.024	-.020	-.029
Learning Environment Stimulation	.126*	.184*	.153*	.101*	.097*

Key: *Correlation significant α = 0.05 level (2-tailed), **PR**= Personal Relevance, **U** = Uncertainty, **CV**= Critical voice, **SC**= Shared Control, **SN**= Student Negotiation

Table 16 shows that correlations between actual learning environment and self-efficacy, performance goal and achievement goal were not statistically significant. The correlations between actual learning environment and active learning strategies and Biology learning value were all negatively statistically significant (p <.05). The actual learning environment and learning environment stimulation variable correlations were the only ones that were positively statistically significant (p < .05).

These findings can be explained using the mean scores of students in both actual learning environment subscales and motivational variables. The students from low achieving schools had relatively higher scores of actual learning environment than scores on self-efficacy, active learning strategies and Biology learning value subscales of SMQ. This led to negative correlations. Their scores on the scales on performance goal and achievement goal were relatively as high as their scores on the learning environment variables which led to most of the correlations being positive. The statistics indicate that the students from low achieving schools use superficial cognitive strategies to learn Biology (Tang & Neber, 2008). This could be the reason why they have low self-efficacy beliefs. On the other hand, the students in the low achieving schools seem to be more focused on competing with other students and their desire to get attention from the teacher (Cavas, 2011). They also derive satisfaction from validating their competence and achievement during science lessons (Palmer, 2005). Table 17 shows correlations between students' perceptions of preferred learning environment and motivation among the students in high achieving schools.

Table 17: Correlations between Perception of PLE and Motivation among HAS

	High Achieving Schools (HAS), N = 399				
Variables	**PR**	**U**	**CV**	**SC**	**SN**
Self-Efficacy	.428*	.269*	.122*	.190*	.471*
Active Learning Strategies	.310*	.174*	.069	.171*	.375*
Biology Learning Value	.347*	.131*	.185*	.053	.273*
Performance Goal	-.408*	-.154*	-.133*	-.078	-.415*
Achievement Goal	-.366*	-.157	-.095	-.090	-.398*
Learning Environment Stimulation	.377*	.208*	.107*	.096	.382*

Key: *Correlation significant α = 0.05 level (2-tailed), **PR**= Personal Relevance, **U** = Uncertainty, **CV**= Critical voice, **SC**= Shared Control, **SN**= Student Negotiation

Table 17 indicates that the correlations between the constructivist learning environment variables(Preferred Learning Environment) and self-efficacy, active learning strategies, biology learning value and learning environment stimulation are statistically significant (*p* <.05) except critical voice with active learning strategies, shared control and Biology learning value and learning environment stimulation. This indicates that they employ higher order cognitive strategies (Tang & Neber, 2008). Constructivist learning environment variables were negatively statistically significant with performance goal and achievement goal ($p < .05$). This indicates that the students from high achieving schools scored lower on performance and achievement subscales of the motivation and higher on the preferred learning environment. According to Mucherah and Frazier (2013) such kinds of students do not have a performance goal orientation. This contributed to negative correlations. Table 18 shows the correlations between the preferred leaning environment and motivation among the low achieving schools.

Table 18: Correlations between Perceptions of PLE and Motivation among LAS

	Low Achieving Schools (LAS), N = 416				
Variables	**PR**	**U**	**CV**	**SC**	**SN**
Self-Efficacy	.154*	.073	-.076	.360	.301*
Active Learning Strategies	0.066	.029	-.035	-.112*	.157*
Biology Learning Value	.106*	.147*	-.091	-.218*	.204*
Performance Goal	-.113	-.108*	.042	-.018	-.316*
Achievement Goal	-.114*	-.086	.021	-.020	-.269*
Learning Environment Stimulation	.172*	.094	-.099	.101*	.340*

Key: *Correlation significant α = 0.05 level (2-tailed), **PR**= Personal Relevance, **U** = Uncertainty, **CV**= Critical voice, **SC**= Shared Control, **SN**= Student Negotiation

Table 18 indicates that the correlations between the personal relevance and student negotiation scales of the constructivist learning environment were positively statistically significant with self-efficacy, active learning strategies, Biology learning value and learning environment stimulation. Performance goal and achievement goal were negatively statistically significant with student negotiation ($P < .05$). Personal relevance scale was positively statistically significant with self-efficacy, Biology learning value and learning environment stimulation. It was negatively statistically significant with achievement goal ($p < .05$). Shared control was negatively statistically significant with active learning strategies and Biology learning value ($p < .05$). Critical voice was not statistically significant with any of the motivational variables. Most of the learning environment variables are negatively statistically significant with performance goal and achievement goal. This still indicates that the students in low achieving schools are more intent on demonstrating their ability to others and attracting the teachers' attention (palmer, 2005) and validating their competence and achievement during Biology learning (Cavas, 2011). The students in low achieving schools have a low quality of task engagement hence do not use active learning strategies (Cavas, 2011). The findings in Table 18 indicate that if there is a mismatch between the nature of the actual learning environment and preferred learning environment there will be a consequent decrease in learning outcomes (Harris, 2013).

It was also necessary to carry out multiple regression analyses on the predictors (actual learning environment) and collective dimensions of the dependent variable (student total score on SMQ) from students in high achieving and low achieving schools. The results are shown in Table 19.

Table 19: Multiple Regression Analyses on ALE and Motivation by School Type

	Model 1-HAS, N = 399			**Model 2-LAS, N = 416**		
	R^2	*F*	*p*	R^2	*F*	*p*
	.013	1.026	0.402	.005	0.407	.844
Variable	Beta	*t*	*p*	Beta	*t*	*p*
Personal Relevance	-.054	-.841	.401	.035	.663	.507
Uncertainty	.052	.854	.394	-.025	-.494	.621
Critical Voice	.054	.954	.341	.054	1.041	.298
Shared Control	.091	1.670	.096	-.046	-.796	.427
Student Negotiation	-.027	-1.409	.682	-.013	-.243	.808

Key: Predictors: Personal relevance, uncertainty, critical voice, shared control and student negotiation **Dependent variable**: Score on Student Motivation Questionnaire

Table 19 indicates that the regression effects for the two models were not statistically significant. It indicates that the first and the second multiple regression models with all the five predictors did not significantly explain the variance in student motivation in high and low achieving schools. This indicates that the existing (actual) learning environment did not significantly predict the motivation of students in high and low achieving schools. This corroborates the assertion that the quality of actual learning environments is a determinant of affective outcomes like motivation (Fraser, 2007; Opolot-Okurut, 2010; Fraser, 2012). The implication is that the actual learning environment did not contribute to their motivational orientation.

It was also necessary to carry out multiple regression analyses on the predictors (preferred learning environment) and collective dimensions of the dependent variable (student total score on SMQ) from high achieving and low achieving schools. The results are shown in Table 20.

Table 20: Multiple Regression Analyses on PLE and Motivation by School Type

	Model 1-HAS, N = 399			**Model 2-LAS, N = 416**		
	R^2	*F*	*p*	R^2	*F*	*p*
	.105	9.252	0.000	.032	2.700	.020
Variable	Beta	*t*	*p*	Beta	*t*	*p*
Personal Relevance	.176	2.146	.032	-.014	-.191	.848
Uncertainty	.118	1.425	.035	-.004	-.057	.955
Critical Voice	.349	3.991	.000	.054	.889	.375
Shared Control	.020	.320	.749	.183	1.573	.006
Student Negotiation	-.013	-.185	.853	.104	1.608	.009

Key: Predictors: Personal relevance, uncertainty, critical voice, shared control and student negotiation **Dependent variable**: Score on Student Motivation Questionnaire

Table 20 indicates that the first multiple regression model with all the five predictors explained 10.5% of the variance in motivational score in high achieving schools (R^2 = .105), F (5,393) = 9.252, $p < .05$. The two variables that were positively and statistically significant are personal relevance ($ß$ = .176, t = .2.146, $p > .05$) and critical voice ($ß$ = .349, t = 3.991, $p > .05$). The rest of the variables were not statistically significant with the motivation of students from high achieving schools. The motivation of the students in high achieving schools was primarily predicted by higher levels of personal relevance, uncertainty and critical voice. The second multiple regression model with the five predictors produced 3.2% of the variance in the motivational score of students from low achieving schools (R^2 = .032), F (5,410) = 2.700, $p < 0.05$. It is only shared control that was positively statistically significant ($ß$ = .183, t = 1.573, $p > .05$). The rest of the variables were not statistically significant. The motivation of students from low achieving schools was primarily predicted by higher levels of shared control and student negotiation. Their motivation was also predicted by lower levels of personal relevance and uncertainty.

The statistically significant regression effect shows that the prediction of the independent variables is accomplished better than can be done by chance. The results indicate that the preferred (constructivist) learning environment variables are better predictors of motivation of students in high achieving schools compared to that of the students from low achieving schools. The perceptions of students from high achieving schools of the preferred learning environment are lower than those from low achieving schools; On the other hand, the students from high achieving schools are more naturally motivated to learn Biology. In this regard they are likely to activate cognitive strategies for learning (Tang & Neber, 2008). The students from low achieving schools are less motivated but have high preferences for a constructive learning environment this makes their motivation to be more dependent on the nature of the learning environment. These findings can be interpreted from the nature of high achieving students and low achieving students. The high achieving students usually have a high level of motivation and independence (Martinez & Snider, 2006; Trna, 2014). Due to this, they are likely to be comfortable with situations that enhance independence as opposed to negotiation characteristic of constructivist learning environment. They are also likely to view the learning environment as positive and offering challenges and opportunities for personal development. The students from low achieving schools on the other hand are naturally less motivated and dependent on the extrinsic factors of the learning environment for their achievement. They seem to have an external locus of causality (Palmer, 2005). Due to this, they are likely to attribute their performance or non-performance to extrinsic factors of the Biology learning environment. The excerpts below show the views of students from the school types of their motivational strategies.

"HAS$_2$ *"when learning new Biology concepts, I try very much to compare what I learnt earlier with what I am learning at the moment. I find this helping me to understand Biology well"*
LAS$_2$ *"when I meet new ideas, I try to understand as it is. Sometimes the new idea is not related to the past knowledge. There are times when I give up".*

The analysis from the interview data indicates that the students from high achieving schools have high levels of self-efficacy since they are able to persist in attempts to understand in the face of encounter of difficult concepts (Nelson & Debacker, 2000). They embrace the active learning strategies and are able to construct new biological knowledge based on their previous understanding (Tang &Neber, 2008). They are able to use previous biological knowledge to create links with the current Biology concepts they encounter in the learning environment. They use cognitive and metacognitive strategies to integrate personal knowledge with scientific knowledge through conceptual change. On the other hand, the students from the low achieving schools can easily give up when they come across concepts that are difficult. This was confirmed by Bandura (1982) who posited that low achievement lowers students' self-efficacy. The following excerpt summarizes motivational views of students for participating in Biology lessons.

“**HAS_2** *“I participate in Biology lessons because I want to understand Biology concepts and apply them in my everyday life. I want to have a better understanding of various things about human life. I feel most happy when I am able to understand a concept in Biology that was not easy to understand”*

LAS_2 *“I participate in Biology lessons because I want to get a good grade in Biology so that I may get to college. Without a good grade you cannot make it. I feel most happy when I get a good grade in Biology because everybody will be happy with me like my teacher and parents”.*

The indication from the excerpts above is that the students from high achieving schools are interested in the practical relevance of the subject. They also apply scientific knowledge to make sense of the world around them (Lee & Brophy, 1996; Tas & Cakir, 2014). In so doing, the students in high achieving schools are able to discover relevance of biological knowledge. On the other hand, the students in low achieving schools do not show strong inclination to relate the previous biological knowledge with the current knowledge they are encountering in the learning environment. They display a low quality of task engagement in the Biology classrooms. According to Lee and Brophy (1996) such students content themselves with strategies for meeting accountability pressures with the least possible effort.

The students from high achieving schools are driven by the desire to have a conceptual understanding of Biology concepts. The students from high achieving schools are most satisfied when they are able to conceptualize a difficult concept in Biology. This indicates that they expend more effort on learning, understanding and developing competence in Biology as a domain of learning. The implication is that they have a drive to master the task at hand instead of self-presentation compared to others (Kaplan & Maehr, 2007). On the other hand, the students in low achieving schools are driven by the desire to get good grades. They are most fulfilled when they attain good grades in Biology. This indicates they are focused on demonstrating and validating their competence. They are more concerned about self-presentation compared to others (Anderman & Anderman, 2010).

The results from the studies by Opolot-Okurut (2010) and Fok and Watkins (2010) indicated that there existed statistically significant associations between perception of learning environment and motivation in the domains of Mathematics and Economics respectively. Arisoy (2007) specifically found out strong associations between constructivist learning environment variables and motivation to learn science among primary school pupils. The current study has specifically revealed statistically significant correlations between the perception of Biology constructivist learning environment and motivation among the high and low achieving schools.

The findings from this study indicated that the actual learning environment is not a better predictor of student motivation among students in high achieving schools and low achieving schools. On the other hand, of the preferred learning environment variables, personal relevance and critical voice are strong predictors of student motivation among high achieving schools while shared control and student negotiation are strong predictors of student motivation among students in low achieving schools. The implication is that when the students from high achieving schools perceive the Biology learning environment as emphasizing relevance of the subject to daily life and providing for opportunities to express their thoughts , ideas and pedagogical impediments to learning, they will be motivated to learn Biology. On the other hand, when the Biology learning environment allowed for co-planning and co-management with the students and also gave opportunities for the learners to raise concerns about pedagogical plans they will be motivated to learn Biology.

4.5 Perception of Learning Environment and Attitude

To test the null hypothesis that there is no significant relationship between students' perception of learning environment and attitude towards Biology, descriptive statistics are first presented, followed by Pearson Correlation Analyses and Multiple Regression Analyses. Qualitative data are used to discuss the inferential statistics. Assumptions of normality, homoscedasticity, linearity and independence were met prior to multiple regression analysis. To detect multicollinearity among the independent variables, correlation matrices, Tolerance and Variance Inflation factor were used. Table 21 shows the descriptive statistics of students' scores in SAQ by school type.

Table 21: Descriptive Statistics of Scores of Students on Attitude by School Type

	HAS, N = 399		**LAS, N = 416**	
SAQ Variables	**Mean**	***SD***	**Mean**	***SD***
Interest	3.947	.204	3.453	.2544
Future Career	3.883	.238	3.157	.3308
Importance	4.076	.240	3.947	.2262
Biology Teacher	3.382	.240	2.710	.2598
Difficulty	3.671	.181	2.985	.3321
Equipment	3.282	.207	2.628	.2385

Key: HAS = High Achieving Schools, **LAS** = Low Achieving Schools, **SAQ** = Student Attitude Questionnaire

Table 21 indicates that the students in high achieving schools had higher scores in SAQ variables than those in low achieving schools. The highest score in all the school types came from the sub-scale of importance of Biology. The lowest scores in all the school types came from the sub-scale of attitude towards use of Biology equipment. Table 21 also indicates that the students from high achieving schools generally have a more positive attitude towards Biology as compared to the students from the low achieving schools. The students from the low achieving schools generally have lower attitude levels compared to the high achieving schools with regard to the Biology teacher, difficulty and equipment. This could be related to how they perceive the learning environment (Nasr, 2011). Indicating that the Biology teacher, the difficulty level of the subject and level of equipment use contributes to lower attitude levels of the students in low achieving schools compared to the students in high achieving schools. The following excerpts from students in High and low achieving school summarize their experience in the classrooms.

HAS_3 *" I would like to do Biology in the future since I understand it well. Our teacher gives us work to do and I like doing assignments given to us. The experiments of Biology are very useful to us since I am able to understand better and that makes the subject interesting"*

LAS_3 *" I would like to do biology in the future but I don't do well in the subject. Our teacher does not give us chance to do practical in Biology as I would wish. We have many theory lessons. This makes the subject really difficult. I would like to do experiments so that I understand the subject well and use the knowledge to explain Biology concepts"*

The excerpt from the high achieving school shows that the quality of the learning environment is an important determinant of career choice (Prokop et al, 2007). The prevailing pedagogic environment has an enduring effect on the feelings of the learners towards Biology (Smith & Ezeife, 2010). The teaching quality and classroom experience are important factors that mediate students' attitude towards science and students' career decisions (Logan & Skamp, 2008). The excerpt above from a student in low achieving school indicates the students' choice of Biology as a future career depends on achievement in Biology. This confirms the review by Osborne et al (2003) on 'attitudes towards science' which indicated that students were likely to opt for a science subject depending on the achievement realized in science achievement tests. The students' feelings about the Biology teacher are negative. It appears that the dominant behavior of the teacher in the classroom is didactic. There seem to be little chance accorded to the learners to manipulate Biology equipment. This could be a contributor to the current status of attitude (Kember et al, 2010). They recognize the practical relevance of the subject but the prevailing environment does not provide for this hence their interest is not sustained. This finding indicates that the learning environment that would enhance attitude among the students in low achieving schools is characterized by active involvement of learners, use of a variety of teaching strategies and a Biology that is not disconnected from their ordinary lives (UNESCO, 2012). This would in turn enhance their choice of Biology as a career (Osborne et al, 2003; Miller, 2010). Table 22 shows the simple correlation matrix between scores on SPQ variables and SAQ variables in high achieving schools. This was done to examine the bivariate relationship between each of the actual learning environment variables and each of the attitude scales.

Table 22: Correlations between Perception of ALE and Attitude among HAS

	PR	U	CV	SC	SN
Interest	-.265*	-.182*	-.107*	.013	-.110*
p-value	.000	.000	.033	.803	.028
Future Career	-.196*	-.222*	-.085	-.041	-.123*
p-value	.000	.000	.089	.414	.014
Importance	.031	.003	.021	-.005	.044
p-Value	.539	.946	.673	.915	.383
Biology Teacher	.135*	-.044*	.155*	-.087*	.036
p-value	.007	.037	.002	.042	.474
Difficulty	.301*	.104*	.189*	-.057	.101*
p-value	.000	.038	.000	.255	.044
Equipment	.349*	.195*	.196*	-.003	.239*
p-value	.000	.000	.000	.959	.000

Key: ***Correlation significant at .05 level (2-tailed), **PR= Personal Relevance, **U** = Uncertainty, **CV =** Critical Voice, **SC**= Shared Control, **SN**= Student Negotiation,

Table 22 indicates that the correlations between interest in Biology and personal relevance, uncertainty, critical voice and student negotiation were negatively statistically significant. This shows that the actual learning environment did not enhance the interest of the students towards Biology. The correlations between actual learning environment and future career were negative. This indicates that the actual learning environment did not engender interest in Biology as a future career (Nasr, 2011). The correlation between personal relevance and critical voice and the Biology teacher were positively statistically significant. This shows that the actual learning environment had these elements to some extent and they enhanced the attitude of learners towards the Biology teacher (Prokop et al, 2007). The correlations between the difficulty of the subject and personal relevance, uncertainty, critical voice and student negotiation were positively statistically significant.

This indicates these elements of a constructivist learning environment were present to some extent and therefore they did not perceive the subject as difficult. The correlation between Biology equipment and personal relevance, uncertainty and critical voice were positively statistically significant. The indication is that the existing learning environment could have enhanced their attitude towards Biology equipment.

Table 23 shows the correlations between the perceptions of students from low achieving schools of the actual learning environment and various attitude subscales. This was done to examine the bivariate relationship between each of the actual learning environment variables and each of the attitude scales.

Table 23: Correlations between Perception of ALE and Attitude among LAS

	PR	**U**	**CV**	**SC**	**SN**
Interest	.006	-.017	.061	.044	.045
p-value	.908	.725	.214	.373	.355
Future Career	0.052	.034	.066	.045	.039
p-value	.292	.487	.177	.359	.432
Importance	.066	-.098	-.043	-.005	-.071
p-Value	.903	.045	.382	.922	.150
Biology Teacher	-.008	-.035	-.024	-.036	.040
p-value	.874	.472	.619	.461	.416
Difficulty	.016	-.024	.000	-.056	.030
p-value	.749	.620	.990	.255	.538
Equipment	.012	-.034	.003	-.021	.018
p-value	.802	.489	.952	.663	.715

Key: ***Correlation significant at .05 level (2-tailed), **PR= Personal Relevance, **U** = Uncertainty, **CV =** Critical Voice, **SC**= Shared Control, **SN**= Student Negotiation, **LAS** = Low Achieving Schools, **ALE** = Actual learning Environment

Table 23 indicates non-existence of statistical significance between actual learning environment and the various attitude variables among students in low achieving schools. It appears that the actual learning environment did not enhance the attitude of students in low achieving schools towards Biology. It indicates that the students' actual learning environment did not provide for opportunities to experience relevance of biological knowledge, the evolution of biological knowledge, to question the pedagogical plans of the teacher, to co-control the Biology learning environment and also did not provide for collaborative learning. This could have contributed to relatively low attitude scores of students among low achieving schools (Lay & Khoo, 2011). Table 24 shows the multiple regression analyses on actual learning environment by school type. This was done to identify which of the actual learning environment variables contributed uniquely and significantly to explain the variance in students' attitudes.

Table 24: Multiple Regression Analyses on ALE and Attitude by School Type

	Model 1-HAS, N = 399			**Model 2-LAS, N = 416**		
	R^2	*F*	*p*	R^2	*F*	*p*
	.019	1.508	0.186	.003	.215	.956
Variable	Beta	*t*	*p*	Beta	*t*	*p*
Personal Relevance	.056	.918	.131	.007	.122	.903
Uncertainty	-.086	-1.514	.213	-.040	-.794	.428
Critical Voice	.066	1.248	.318	.006	.124	.901
Shared Control	-.052	1.000	.437	-.009	-.170	.865
Student Negotiation	.046	.779	.853	.032	.575	.565

Key: Predictors: Personal relevance, uncertainty, critical voice, shared control and student negotiation **Dependent variable**: Score on Student Attitude Questionnaire (**SAQ**),

Table 24 indicates that the regression effects for the two models were not statistically significant. It indicates that the first and the second multiple regression models with all the five predictors did not significantly explain the variance in student attitude in high and low achieving schools. This indicates that the existing (actual) learning environment did not significantly predict the attitude of students in high and low achieving schools. It appears that the actual learning environment in both school types was characterized by the teacher being the focal point of the learning environment (Gregory, 2013). The biological knowledge seemed to be disconnected from the lives of the students (UNESCO, 2010).This corroborates the position that the nature of learning environment is a significant determinant of student attitude outcomes (Dorman & Fraser, 2009). The excerpts below summarize the views of students as regards importance of Biology and preference of the subject.

HAS_3 "*Biology is important for our lives since it helps us to understand our lives as human beings and other living things. Of the three sciences, I like Biology most because it is not difficult. If there was an improvement on teaching, I would do better".*
LAS_3 "*Biology is important to me because I can understand my life well when I study it. When the three sciences are compared, Biology is the simplest. However I don't do well because I don't understand some concepts since they are taught hurriedly to finish the syllabus"*

The excerpt above indicates that the students from both school types find Biology less difficult compared to the other two sciences. This relates to the seminal review of Osborne et al (2003) on 'attitudes towards science' which documented that of the three sciences, Biology is perceived by learners to be simple. The students from both school types recognize the significance of biological knowledge as important to their lives, however it appears that students from low achieving schools feel there is a disconnect between what they learn at school and the reality 'out there' implying inability to establish personal relevance (Logan & Skamp, 2008; UNESCO, 2010). It appears the students' participation in the actual learning environment is minimal with the teacher being the source of all knowledge and instruction (Gregory, 2013). Students from low achieving schools feel that the nature of the curriculum does not give them the time to reflect and build on their scientific ideas due to copious amount of content to be tackled (Logan & Skamp, 2008). Table 25 shows the correlations between the constructivist learning environment (PLE) and attitude of students among students in High achieving schools.

Table 25: Correlation between Perception of PLE and Attitude among HAS

	PR	**U**	**CV**	**SC**	**SN**
Interest	.284*	.301*	.301*	.249*	.274*
p-value	.000	.000	.000	.000	.000
Future Career	.284*	.345*	.347*	.314*	.328*
p-value	.000	.000	.000	.000	.000
Importance	.037	.063	.037	.000	.055
p-Value	.461	.211	.464	.985	.277
Biology Teacher	.275*	.260*	.229*	.189*	.278*
p-value	.000	.000	.000	.000	.000
Difficulty	.117*	.134*	.137*	.050	.144*
p-value	.019	.007	.006	.318	.004
Equipment	.100*	.076	.063	.061	.117*
p-value	.045	.130	.209	.222	.020

Key: ***Correlation significant at .05 level (2-tailed), **PR= Personal Relevance, **U** = Uncertainty, **CV =** Critical Voice, **SC**= Shared Control, **SN**= Student Negotiation, **HAS** = High Achieving Schools, **PLE** =Preferred Learning Environment

Table 25 indicates that the correlations of attitude subscales of interest, future career, and Biology teacher were positively statistically significant with all the preferred learning environment variables among the high achieving schools. The results indicate that there exists a relationship between the perception of constructivist learning environment and attitude of students in the high achieving schools with regard to interest, future career, Biology teacher and difficulty of the subject. In other words when the students perceive the learning environment as constructivist, they develop interest in the subject, they have aspirations for pursuing a future career in Biology, they view the Biology teacher positively, they do not view Biology subject as difficult (Nasr, 2011). According to Logan and Skamp (2008) a learning environment that makes science relevance to the students lives, which gives learners time to reflect and build their scientific understanding, that recognizes the students ideas enhances their attitude to school science. Table 26 shows the correlation matrix between preferred learning environment and attitude of students in low achieving schools.

Table 26: Correlation between Perception of PLE and Attitude among LAS

	PR	**U**	**CV**	**SC**	**SN**
Interest	-.028	-.078	-.058	.034	-.085
p-value	.574	.013	.237	.490	.089
Future Career	-.029	-.017	-.056	.049	-.032
p-value	.555	.734	.803	.322	.541
Importance	-.097	-.083	-.094	-.087	-.082
p-Value	.064	.094	.056	.077	.097
Biology Teacher	-.106	-.026	-.063	.089	-.037
p-value	.031	.621	.200	.977	.443
Difficulty	-.080	-.042	-.069	-.050	-.092
p-value	.104	.397	.158	.910	.061
Equipment	-.052	-.076	-.047	-.057	-.086
p-value	.286	.780	.342	.998	.081

Key: *Correlation significant at .05 level (2-tailed), **PR**= Personal Relevance, **U** = Uncertainty, **CV =** Critical Voice, **SC**= Shared Control, **SN**= Student Negotiation, **LAS** = Low Achieving Schools, **PLE** = Preferred Learning Environment

Table 26 indicates that the attitude subscales and the constructivist learning environment variables did not reveal a statistically significant relationship at an alpha level of .05 among the low achieving schools. The results from Table 26 can be explained using the descriptive statistics in Table 6 and 21. Table 6 shows that the students in low achieving schools have high preferences for preferred learning environment; whereas Table 21 shows that the students in low achieving schools had comparatively low attitude scores. A correlation of high and low scores leads to negative correlations. Despite the fact that their attitude towards Biology is slightly positive, they have high preference for a constructivist learning environment. It appears that the prevailing learning environment made the learners in low achieving schools to have feelings, beliefs and behaviors that were negative towards Biology (Osborne et al, 2003). Their high perceptions of a preferred learning environment did not contribute to positive attitude towards the subject. This does not mean high perceptions of the preferred learning environment causes low attitude to the subject; rather it seems to imply that they attribute their negative attitude towards Biology to the unfavorable existing learning environment.

Table 27 shows the results of the multiple regression analysis on preferred learning environment variables and collective dimensions of attitude as measured by Student Attitude Questionnaire (SAQ). This was done to identify which of the learning environment variables contributed uniquely and significantly to the explanation of variance in students attitudes in high and low achieving schools.

Table 27: Multiple Regression Analyses on PLE and Attitude by School Type

	Model 1-HAS, N = 399			**Model 2-LAS, N = 416**		
	R^2	*F*	*p*	R^2	*F*	*p*
	.193	18.847	0.000	.021	1.770	.118
Variable	Beta	*t*	*p*	Beta	*t*	*p*
Personal Relevance	.042	.541	.589	-.125	-1.717	.087
Uncertainty	.148	1.872	.042	.033	.480	.631
Critical Voice	.097	1.168	.244	-.049	-.797	.426
Shared Control	.043	.720	.472	.111	1.685	.093
Student Negotiation	.184	2.734	.004	-.083	-1.287	.199

Key: Predictors: Personal relevance, uncertainty, critical voice, shared control and student negotiation **Dependent variable**: Score on Student Attitude Questionnaire (**SAQ**)

Table 27 indicates that the first regression model with all the five predictors explained 19.3% of the variance in students attitude towards Biology among the students in high achieving schools (R^2 = .193), F (5,393) = 18.847, p < 0.05. The two variables that were positively statistically significant were uncertainty (*ß* = .148, *t* = 1.872, *p* < .05) and student negotiation (*ß* = .184, *t* = 2.734, *p* < .05). The rest of the variables were not statistically significant with the attitude of students from high achieving schools however were positive. The second multiple regression model with all the five predictors explained 2.1% of the variance in students attitude towards Biology among the students in low achieving schools (R^2 = .021), *F* (5,410) = 1.717, *p* > 0.05. This indicates that the regression effect for the second model was not statistically significant.

The statistically significant regression effect for preferred learning environment and attitude for students in high achieving schools show that the prediction of the dependent variables is accomplished better than can be done by chance. The strongest predictor of student attitude towards Biology is student negotiation followed by uncertainty. The second multiple regression model with all the five predictors did not significantly explain the variance in student attitude towards Biology among students in low achieving schools. This indicates that the constructivist learning environment did not significantly predict the attitude of students the low achieving schools. It shows that a mismatch between the actual learning environment and preferred learning environment is contributor to decreased attitude (Aldridge, Dorman & Fraser, 2004). It appears the existing learning environment had stronger influence on the attitude of the students towards to Biology. The following excerpts summarize responses from students in high achieving schools and low achieving schools.

HAS_3 *"I like Biology because of its value and my future career is related to it. My teacher values us and wants us to participate in the Biology lessons. I don't find the subject difficult compared to other sciences because of the way it is taught"*
LAS_3 *" I would like to do Biology in the future because it is useful in our lives. The teacher of Biology sometimes does not even appreciate our ideas and I feel shamed".*

The interview data indicate that the students would like to do Biology because of its intrinsic value and because of career aspirations. It appears the students take the Biology teacher as a role model for deciding about their career (Osborne et al, 2003; Kember et al, 2010). The teacher plays a central role in establishing the overall classroom environment (Ying, 2008). The teaching quality in the classroom is one of the key factors that impacts on students' attitude to and engagement with science (Prokop et al, 2007; Logan & Skamp, 2008). When the teacher creates a favorable learning environment, by recognizing student ideas and actively involving students in biological tasks, the attitude of the learners towards the subject improves (Dorman & Fraser, 2009). It appears that the teachers' personality and communication methods also impact on the attitude that the learners develop within the learning environment (Hanrahan, 2006). The learners are very sensitive to the teachers' comments in the learning environment and these can determine whether they engage with what goes on in the learning environment or not.

The findings from this study are generally in agreement with the previous findings from learning environment–attitude nexus studies (Koul & Fisher,2003;Telli, Cakiroglu & Den brok, 2006; Smith & Ezeife, 2010; Lay & Khoo, 2011;Tran, 2012; Santiboon et al., 2012; Afari et al, 2013). These studies revealed statistically significant associations between the perceptions of learning environment and attitude in various domains. The study by Arisoy (2007) revealed positive correlations between all constructivist learning environment variables and attitude towards science in general among primary school pupils.

The current study has documented the relationship between constructivist learning environment and attitude in the high and low achieving schools in Biology. It has indicated negative correlations between constructivist learning environment variables and attitude among low achieving schools. At the same time, there were statistically significant positive correlations between the constructivist learning environment variables and four of the six attitude scales among the students in high achieving schools. The implication from the current study is that the quality of the actual learning environment is a determinant factor predicting the attitude of the students in both high and low achieving schools.

4.6 Gender Differences in Perception of Learning Environment

To test the hypothesis that there is no significant gender difference in perception of Biology learning environment, descriptive statistics are presented first thereafter, independent sample t-tests are conducted. Interview data are used to explain inferential statistics. The analysis was performed with the significance level of 0.05. The descriptive statistics for students' perceptions of actual learning environment according by gender are summarized in Table 28.

Table 28: Descriptive Statistics for Perception of ALE in terms of Gender

	Boys, N = 466; Girls, N = 349		
SPQ scales	**Gender**	**Mean**	**SD**
Personal Relevance	Boys	2.200	.3873
	Girls	2.156	.2943
Uncertainty	Boys	2.252	.3121
	Girls	2.215	.2678
Critical Voice	Boys	2.194	.2908
	Girls	2.196	.2801
Shared Control	Boys	2.096	.3063
	Girls	2.117	.2914
Student Negotiation	Boys	2.286	.4377
	Girls	2.273	.3872

Key: **SPQ** = Student Perception Questionnaire, **ALE** = Actual Learning Environment,

Table 28 shows the boys and girls perceive their actual learning environment as not offering enough opportunities for them to relate Biology to their context of learning, experience the provisional status of biological knowledge, question pedagogical strategies in Biology learning freely, co-control Biology learning environment and not providing for cooperative and collaborative learning. This is depicted by the mean scores falling below the mid-point average. On the other hand the boys perceive the actual learning environment better than the girls in terms of personal relevance, uncertainty, and student negotiation. It appears boys are more concerned with the investigative aspects of the learning environment (Yang, 2013). The girls perceive the actual learning environment better than the boys in terms of critical voice and shared control. It appears the girls are more concerned with the relational aspects of the learning environment (Telli et al, 2006). The implication is that the actual learning environment was characterized by direct transmission approaches and student control ideologies (Beyhan, 2013). It was necessary to carry independent sample t-test to find out if the differences indicated in Table 28 were statistically significant. Table 29 shows the levene's test for equality of variances and t-tests for equality of means. The levene's tests for the subscale of personal relevance produced non-significant results t-test analyses for the rest of the subscales are based on equal variances assumed.

Table 29: Independent Sample t-tests for ALE in terms of Gender

	Group 1= Boys, N = 466; Group 2 = Girls, N = 349						
	Levene's tests		**The t-tests**				
SPQ Scales	*F*	Sig	*t*	df	*p*	MD	SEM
Personal Relevance	8.456	0.004	1.900	812.826	0.058	.0454	.02388
Uncertainty	.682	0.409	1.781	813	0.075	.0371	.02081
Critical Voice	2.391	0.122	-.132	813	0.895	-.0261	.01969
Shared Control	0.171	0.680	-.976	813	0.329	-.0207	.02124
Student Negotiation	3.111	0.078	.441	813	0.659	0.0130	.02951

*$p< 0.05$ Key: **SEM** = Standard Error Mean, **ALE =** Actual Learning Environment
MD =Mean Difference

Table 29 indicates absence of statistically significant gender differences between boys and girls in perception of the actual learning environment as depicted by *p* values greater than 0.05 and very low mean differences. The indication is that both boys and girls perceived the actual learning environment in more or less the same way. It shows that the actual learning environment did not evoke any differences in perception. The findings indicate that the actual pedagogical environment was more or less uniform in terms of lower levels of personal relevance, uncertainty, critical voice, shared control and student negotiation. This finding is similar to that of Tran (2013) who found non-significant differences in perception of Mathematics actual learning environment using My Classroom Inventory (MCI) questionnaire. Table 30 shows the descriptive statistics for perception of the preferred learning environment in terms of gender.

Table 30: Descriptive Statistics for Perception of PLE in terms of Gender

	Boys, N = 466; Girls, N = 349		
SPQ scales	**Gender**	**Mean**	**SD**
Personal Relevance	Boys	3.912	.5190
	Girls	4.119	.4097
Uncertainty	Boys	3.841	.5092
	Girls	4.125	.4382
Critical Voice	Boys	3.819	.6407
	Girls	4.130	.4925
Shared Control	Boys	3.996	.4415
	Girls	4.153	.3681
Student Negotiation	Boys	3.937	.4885
	Girls	4.145	.4663

Key: **SPQ** = Student Perception Questionnaire, **PLE** = Preferred Learning Environment,

Table 30 indicates that the perception of girls was higher than that of boys in all the subscales of the preferred learning environment. This shows that the girls' preference level for the constructivist learning environment is higher than that of boys. On the other hand, the preference levels for both boys and girls are above the mid-point average indicating that both boys and girls prefer a constructivist learning environment that relates what is taught in the classroom to the practical life outside, that explicates the evolution and provisional status of biological knowledge; where they question the methods of teaching Biology freely; where they co-control Biology learning process with the teacher and which provides for cooperative learning (Kwan & Wong, 2014).

It was necessary to carry out independent sample t-tests to find out if the differences in Table 30 are statistically significant. Table 31 shows the levene's test for equality of variances and t-tests for equality of means. The levene's tests for the subscale of personal relevance, uncertainty and critical voice produced significant results. On the other hand, the tests for shared control and student negotiation produced non-significant results hence their t-test analyses are based on equal variances assumed.

Table 31: Independent Sample t-tests for PLE in terms of Gender

	Group 1= Boys, N = 466; Group 2 = Girls, N = 349						
	Levene's tests		**The t-tests**				
SPQ Scales	*F*	Sig	*t*	df	*p*	MD	SEM
Personal Relevance	32.927	0.000	-6.357	810.725	0.000	-.2069	.03255
Uncertainty	14.392	0.000	-8.536	797.452	0.000	-.2839	.03327
Critical Voice	85.017	0.000	-7.833	812.437	0.000	-.3119	.03970
Shared Control	2.371	0.124	-5.407	813	0.000	-.1575	.02914
Student Negotiation	.795	0.373	-6.289	813	0.000	-.2081	.03310

*$p < 0.05$ Key: **SEM** = Standard Error Mean, **PLE =** Preferred Learning Environment
MD =Mean Difference

Table 31 indicates that there existed statistically significant differences in perception of the preferred learning environment between boys and girls in favor of girls as depicted by negative t- values and negative mean differences. This indicates that the girls have high expectations from the learning environment and also shows that the actual learning environment did not adapt to their preferences. Harris (2013) has noted that when the nature of the actual learning environment is extremely below the learner's expectations, their perceptions of the preferred learning environment will be higher. Yates (2011) has noted that in co-educational learning environment settings, boys receive more academic attention and support from teachers than girls. This kind of differential treatment in the learning environment can engender higher expectations and preferences among girls. On the other hand, it can make boys to have lower perceptions of the preferred learning environment than girls since their expectations are well addressed to some extent.

Kwan and Wong (2014) did not find gender differences in perception of constructivist learning environment among grade 9 students of Hong Kong who were doing liberal studies. It would appear that different learning environments and subject domains engender different perceptions of learning environments. For example in Hong Kong, great strides have been made to address the 21st century challenges of education by implementing policies that minimize gender differences (Kwan & Wong, 2014). The excerpts below show students' perceptions of preferred learning environment by girls and boys with regard to personal relevance and uncertainty.

Girl$_4$: *"I would be glad to with a situation where what we learn in biology classes compare well with what is out there. If it is about the heart as an organ, it would be better if we dissect an organism and we see the heart and other parts of the body. Or even videos that show how the heart works. I would also like to know that the knowledge of biology has been changing".*

Boy$_4$: *"Sometimes the teacher shows us some of the things that happen in real life using simple experiments, but I would like more of real life situations. Some biological explanations have changed with time. This can be known by comparing what we were taught in primary school with what we learn at the moment"*

.

The excerpt above confirms that the expectations of girls with regard to the learning environment are higher than that of the boys. The girls prefer the learning environment that is more relevant in terms of the learning materials and activities that places the student in the midst of everyday life or through imitations of reality. Gregory (2013) refers to this kind of environment as authentic learning environment. The girls also prefer an environment where they experience the provisional status of biological knowledge (Telli et al, 2009). The boys on the other hand appear to be content with the status quo. Their perception of the preferred learning environment is largely influenced by the few experiences in the actual learning environment. The boys seem able to relate prior learning experiences to the present learning experiences (Santrock, 2009). The excerpt below shows the summary of the boys and girls perception of the learning environment with regard to shared control and critical voice.

Girl$_4$: *"We should also complain if the teachers' way of teaching does not help us to understand better. I will be happy to help the teacher plan for our lesson. I will check for the apparatus for the teacher, I will be ready to learn and even read ahead of the lesson and get to know what is to be learnt early".*

Boy$_4$: *"I could question the teachers' way of teaching but I don't know how to teach. I can help the teacher if he asks me to help him. Remember, he has more knowledge than us. I can help him plan a few times because I also have a lot to do".*

The girls and boys seem to have high preferences for critical voice, a situation where they question the pedagogical approaches of the teacher. The boys too seem to have ideals for the same but unsure of how it can be actualized and at the same time helpless. The boys appear to be contented with the situation where they are on the receiving end of the instruction (Beyhan, 2013). The girls on the other hand recognize the fact that a teacher is a human being and is prone to pedagogical ineffectiveness. The girls go further to hold that it is possible to negotiate favorable learning environment without being seen to be undisciplined.

The findings relate to some of the previous studies on learning environment from a general perspective (Quek et al., 2002; Arisoy, 2007; Fisher & Kongkarnka, 2008; Wahyudi & Treagust, 2004; Den Brok et al, 2006; Telli et al., 2009; Brown et al, 2009).

These studies indicated the existence of gender differences in perception of learning environment in favor of girls. However the studies by Murugan and Rajoo (2013), Kwan and Wong (2014) indicated non-significant gender differences.

The current study has indicated the absence of gender differences in perception of actual learning environment. However, there are gender differences with regard to perception of the constructivist learning environment in favor of girls. The non-significant gender differences suggest the similarity of the actual learning environments from the lens of gender. The significant gender differences in favor of girls could also be due to the nature of Biology content that the students are exposed to at this stage of their learning. The content areas at this stage include excretion and homeostasis, respiration, gaseous exchange and transport in animals. These content areas are mainly concerned with human Biology which has been known to be more interesting to the girls (Telli et al, 2009). This interest is likely to make the girls to expect more from the learning environment.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

In this chapter, the summary of major findings, conclusions and recommendations of the study on relationship between students' perception of Biology learning environment and their Achievement, motivation and attitude in co-educational secondary schools in Siaya County have been presented. The presentation has been done according to the study objectives.

5.2 Summary of Findings

This study has produced the following findings:

5.2.1 Perception of Biology Learning Environment

The hypothesis test that 'there is no significant difference between students' perception of actual and preferred learning environment' yielded the following findings: The quantitative findings from paired t-tests revealed that among the students in high and low achieving schools there existed statistically significant differences in perception between actual and preferred learning environment in terms of personal relevance, uncertainty, critical voice, shared control and student negotiation at $\alpha = 0.05$ in favor of preferred learning environment: Independent sample t-tests revealed no statistically significant school type differences in perception of actual learning environment in terms of critical voice and shared control and statistically significant school type differences with regard to personal relevance, uncertainty and student negotiation in favor of students in high achieving schools at $\alpha = 0.05$: Independent sample t-tests also revealed statistically significant school type differences between preference for a constructivist learning environment in favor of students in low achieving schools in terms of personal relevance, uncertainty, critical voice , shared control, and student negotiation at $\alpha = 0.05$.

5.2.2 Perception of Learning Environment and Achievement

The null hypothesis test that 'there is no significant relationship between students' perception of learning environment and achievement in high and low achieving schools' yielded the following findings: The findings from the multiple regression analyses indicate that the actual learning environment with all the five predictors explained 6.8% of the variance in the high achieving schools' scores in SAT ($R^2 = 0.068$), F (5, 393) = 2.394, $p > .05$. The actual learning environment with all five predictors produced 14.5% of the variance in the Biology achievement scores of students from low achieving schools ($R^2 = 0.145$), F (5, 410) = 13.726, $p < .05$. The constructivist learning environment with all the five predictors explained 2.8% of the variance in the high achieving schools' scores in SAT ($R^2 = 0.028$), F (5, 393) = 2.270, $p < .05$. The constructivist learning environment with all five predictors produced 6.5% of the variance in the Biology achievement scores of students from low achieving schools ($R^2 = 0.065$), F (5, 410) = 5.667, $p < .05$.

5.2.3 Perception of Learning Environment and Motivation

The null hypothesis test that 'there is no significant relationship between students' perception of learning environment and motivation in high and low achieving schools' yielded the following findings: That the actual learning environment with all the five predictors did not significantly explain the variance in student motivation in high and low achieving schools: The constructivist learning environment with all the five predictors explained 10.5% of the variance in motivational score in high achieving schools (R^2 = .105), F (5,393) = 9.252, $p < .05$; The constructivist learning environment with all the five predictors produced 3.2% of the variance in the motivational score of students from low achieving schools (R^2 = .032), F (5,410) = 2.700, $p < .05$.

5.2.4 Perception of Learning Environment and Attitude

The null hypothesis test that 'there is no significant relationship between students' perception of learning environment and attitude in high and low achieving schools' yielded the following findings: That the actual learning environment with all the five predictors did not significantly explain the variance in student attitude in high and low achieving schools: The constructivist learning environment with all the five predictors explained 19.3% of the variance in students attitude towards Biology among the students in high achieving schools (R^2 = .193), F (5,393) = 18.847, p <.05: The constructivist learning environment with all the five predictors did not significantly explain the variance in students' attitude towards Biology in the low achieving schools, (R^2 = .021), F (5,410) = 1.717, p >.05.

5.2.5 Gender Differences in Perception of Learning Environment

The null hypothesis test 'that there is no significant gender difference in perception of Biology learning environment' yielded the following findings: That there was no statistically significant gender difference in perception of the actual learning environment in terms of personal relevance t (812) = 1.900, $p > .05$; uncertainty t (813) = 1.781, $p > .05$; critical voice t (813) = -0.132, $p > .05$; shared control t (813) = - 0.976, $p > .05$ and student negotiation t (813) = 0.441, $p > .05$: That there was statistically significant gender differences in perception of preferred learning environment in terms of personal relevance t (811) = -6.357, $p < .05$; uncertainty t (797) = -8.536, $p < .05$; critical voice t (812) = -7.833, $p < .05$; shared control t (813) = - 5.407, $p < .05$ and student negotiation t (813) = -6.289, $p < .05$.

5.3 Conclusions

Based on the findings of this study, the following conclusions have been arrived at:

5.3.1 Perception of Biology Learning Environment

The following conclusions are made with regard to perception of Biology learning environment: The students in High and Low achieving schools' have a higher preference for constructivist learning environment than the actual learning environment; The students in high achieving schools have higher preferences for actual learning environment than students in low achieving schools in terms personal relevance, uncertainty and student negotiation and no differences in perception of actual learning environment in terms of critical voice and shared control; The students in low achieving schools have higher perceptions of constructivist learning environment than the students in high achieving schools.

5.3.2 Perception of Learning Environment and Achievement

The following conclusions are made with regard to relationship between perception of Biology learning environment and achievement: The perceptions of actual learning environment are significantly related to achievement in Biology among the students in

High and low achieving schools. The perceptions of preferred learning environment are significantly related to achievement in Biology among the students in high and low achieving schools. However the relationships are weaker for students in high achieving schools for both actual and preferred learning environments compared to low achieving schools.

5.3.3 Perception of Learning Environment and Motivation

The following conclusions are made with regard to the relationship between perception of Biology learning environment and motivation: The actual learning environment is not better predictor of student motivation in high and low achieving schools; the constructivist learning environment is better predictor of student motivation in high and low achieving schools.

5.3.4 Perception of Learning Environment and Attitude

The following conclusions are made with regard to the relationship between perception of Biology learning environment and attitude: The actual learning environment is not better predictor of student attitude towards Biology in high and low achieving schools; the constructivist learning environment is better predictor of student attitude towards Biology in high achieving schools and not a better predictor of student attitude towards Biology in low achieving schools.

5.3.5 Gender Differences in Perception Learning Environment

The following conclusions are made with regard to gender difference in perception of Biology learning environment: There is no gender difference with regard to perception of the actual learning environment of Biology; there is gender difference with regard to perception of Biology constructivist learning environment in favor of girls.

5.4 Recommendations

The following recommendations have been made based on the findings of this study.

5.4.1 Perception of Biology Learning Environment

There is need for the teachers to create the learning environments to make it congruent with what the learners prefer in the high and low achieving schools. By looking at large discrepancies between one or two scales when students' perceptions of actual versus the constructivist learning environment are compared, teachers can tailor an intervention in order to bridge this gap. There is need to bridge the gaps in perception between the schools in terms of their perception of actual and preferred learning environments through interventions.

5.4.2 Perception of Learning Environment and Achievement

There is need for teachers to design the learning environment to make it conform to the constructivist pedagogy. This can be done through effective teacher in-service training on how to create more favorable learning environments in Biology classrooms. This is likely to lead to improved cognition and cognitive achievement in Biology among the High and low achieving schools.

5.4.3 Perception of Learning Environment and Motivation

There is need for teachers to continuously structure the learning environment to bridge the differences between actual and preferred learning environments conform to the constructivist pedagogy in high and low achieving schools since this is likely to enhance the motivation of the learners towards learning Biology. This can be done through creating a learning environment that relates Biology to out of school experiences, where learners experience biological knowledge as provisional, where learners question the teacher's pedagogical strategies, where they co-control the learning environment and finally where there is collaborative and cooperative learning.

5.4.4 Perception of Learning Environment and Attitude

Teachers should make conscious efforts in planning and improving the learning environment to make it congruent with what the learners prefer in order to improve students' attitude towards Biology in high and low achieving schools. There is need to maintain the positive correlations of perception of a constructivist learning environment and attitude among students in high achieving schools, as the attitude of students in low achieving schools towards biology is enhanced through improvement of their learning environments. There is a specific need to incorporate constructivist teaching approaches to enhance the attitude of the learners towards Biology.

5.4.5 Gender Differences in Perception of Learning Environment

Teachers need to take gender differences into consideration when planning for teaching in coeducational schools. There is need to maintain the high preference levels among girls for a constructivist learning environment, and at the same time bridge the differences in perception between boys and girls.

5.5 Suggestions for further research

The following are the suggestions for further research.

1. Studies should be carried out to determine the interaction effect of grade level and gender on perception of students on the constructivist learning environment.
2. Studies should be carried out to determine students' perception of a constructivist learning environment in single-gendered secondary schools.
3. There is need for an interventionist study to determine the effect of constructivist teaching strategy on motivation, attitude and achievement from an experimental perspective.

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APPENDICES

APPENDIX A: Student Perception Questionnaire (SPQ)

The purpose of this questionnaire is to find out how you perceive the Biology classroom learning environment. The participants are assured that the information gathered from this study will be handled with confidentiality and they have the option to withdraw from the study.

a) Instructions

1) Below are statements on actual and preffered Biology learning environment

2) Please give your responses on both actual and preffered learning environments by putting a circle around the choice that corresponds with your opinion

3) Response choices for all items are

A- Almost Always

B- Often

C- Sometimes

D- Less Often

E- Almost Never

b) School………………………Class………Male…………..Female………..sign……....

Actual Classroom In the Biology Classroom	**Preferred classroom** In the Biology Classroom
1.I learn about the world inside and outside of school A B C D E	1.I prefer to learn about the world inside and outside of school A B C D E
2.New learning relates to experiences in and out of school A B C D E	2.I prefer that new learning relates to experiences in and out of school A B C D E
3. I learn how biology is part of their life in and out of school A B C D E	3. I prefer to learn how biology is part of life in and out of school A B C D E
4. I learn about interesting things about the world in and out of school A B C D E	4. I prefer to learn about interesting things about the world in and out of school A B C D E

5. I learn that biology can't always give answers to problems A B C D E	5. I prefer to learn that biology can't always give answers to problems A B C D E
6. I learn that biology explanations have changed with time A B C D E	6. I prefer to learn that biology explanations have changed with time A B C D E
7.I learn that biology is affected by peoples cultural values and opinions A B C D E	7. I prefer to learn that biology is affected by peoples cultural values and opinions A B C D E
8.I learn that biology is a way to raise questions and seek answers A B C D E	8.I prefer to learn that biology is a way to raise questions and seek answers A B C D E
9.I feel safe questioning what and how I am being taught A B C D E	9.I prefer to feel safe questioning what and how I am being taught A B C D E
10. I learn better when I question what and how I am being taught A B C D E	10. I prefer to learn better when I question what and how I am being taught A B C D E
11.I ask for clarity on activities that are confusing A B C D E	11.I prefer to ask for clarity on activities that are confusing A B C D E
12.I express concern about anything that interferes with learning A B C D E	12.I prefer to express concern about anything that interferes with learning A B C D E
13. I help the teacher to plan what we are going to learn A B C D E	13. I prefer to help the teacher to plan what we are going to learn A B C D E
14.I help the teacher to decide how well we learning A B C D E	14.I prefer to help the teacher to decide how well we are learning A B C D E
15. I help the teacher to decide activities that work best for us A B C D E	15. I prefer to help the teacher to decide activities that work best for us A B C D E
16. I let the teacher know if I need more/less time to complete an activity A B C D E	16. I prefer to let the teacher know if I need more/less time to complete an activity A B C D E
17. I talk with other students how to solve a problem A B C D E	17.I prefer to talk with other students on how to solve a problem A B C D E

18. I explain my ideas to other students A B C D E	18. I prefer to explain my ideas to other students A B C D E
19. I ask other students to explain their ideas A B C D E	19.I prefer to ask other students to explain their ideas A B C D E
20. Other students ask me to explain my ideas A B C D E	20. I prefer to be asked by other students to explain their ideas A B C D E

APPENDIX B: Student Achievement Test (SAT)

The purpose of this test is to find out your understanding of the Biology topics covered in form 1. You are assured that your participation is confidential and voluntary. You can withdraw from participation.

a)Instructions:

1. Answer all questions
2. Read questions carefully before answering

b)School……………. Class………………… sign………………...

1. State the name given to the study of cells
A Cytology
B Serology
C Microbiology
D Cerology

2. What is the function of ribosomes?
A- Lipid synthesis
B- Protein synthesis
C- Photosynthesis
D- Starch synthesis

3. Which of the following does not explain how the chloroplast is adapted to its function?
A- Have chlorophyll that traps light
B- Have grana that increase surface area for chlorophyll molecules
C- Stroma has enzymes for catalyzing photosynthesis
D- They are located on upper leaf surface to maximize light absorption.

4. Which of the following statements distinguishes haemolysis and plasmolysis?
A- In haemolysis erythrocytes take in water, burst, in plasmolysis plant cells lose water
B-In haemolysis, plant cells take in water in plasmolysis animal cells lose water.
C-In haemolysis erythrocytes lose water whereas in plasmolysis plant cells gain water.
D-In haemolysis plant cells lose water whereas in plasmolysis animal cells gain water.

5. Which of the following best explains how temperature affects the rate of diffusion?
A-Temperature destroys the cell membrane
B- Temperature increases the cell energy
C- Temperature increases the kinetic energy of the particles
D- Temperature increases the rate of particle motion.

6. What is the role of light in the process of photosynthesis
A-Light energy increases the rate of photosynthesis
B- Light energy splits water molecules
C- Light energy fixes carbon(iv)oxide.
D-Light energy destroys microorganisms.

7. Which of the following explains how the small intestines are adapted to their function?
A-They are short to reduce surface area for absorption
B- They are narrow to reduce contact for digestion
C- They have reduced network of blood capillaries
D- They have thin epithelia to reduce diffusion distance.

8. Name the mode of nutrition where by an organism feeds on dead organic matter.
A- Saprophytism
B- Parasitism
C-Mutualism
D-Symbiosis

9. Which of the following best explains why staining is important in microscopic work.
A-To make the structures observable
B-To highlight some structures within the cell
C-To make structures appear well
D- To make the organelles appear nice.

10. The function of fibre in the human diet is to
A- Provide the body with nutrients
B- Prevent constipation
C- Help in food digestion
D-Transport digested food.

11. The equation below shows the breakdown of hydrogen peroxide to water and oxygen

$$\text{Hydrogen peroxide} \xrightarrow{\text{Enzyme X}} \text{Water} + \text{Oxygen}$$

Name the enzyme X
A-Lactase
B-Carboxylase
C-Sucrase
D-Catalase

12. The diagram below shows a tooth of a human being. Identify the tooth with a reason

	Tooth	Reason
A	Canine	Sharp pointed
B	Premolar	Has one root
C	Incisor	Chisel shaped
D	Molar	Has a smooth surface

13. The table below shows the concentration of some ions in pond water and in the cell sap of an aquatic plant growing in a pond.

Ions	Concentration in pond water (Parts per million)	Concentration in cell sap (parts per million)
Sodium	50	30
Potassium	2	150
Calcium	1.5	1
Chloride	180	200

Name the processes by which sodium and potassium ions could have been taken up by this plant.

	Sodium ions	Potassium ions
A	Osmosis	Diffusion
B	Diffusion	Active transport
C	Osmosis	Active transport
D	Active transport	Diffusion

14. A student picked the leaf below which naturally had white and green patches. The student carried out starch test.

Which of the following diagrams shows the leaf after a starch test?

15. Name the diseases caused by lack of vitamin D and Iodine

	Vitamin D	Iodine
A	Rickets	Goitre
B	Goitre	Rickets
C	Scurvy	Anaemia
D	Goitre	Scurvy

16. State the function of diaphragm in a microscope
A- Regulates the amount of air entering the microscope
B- Concentrates light to the object being observed
C- Regulates the amount of light entering the condenser
D- Directs light to the stage where the specimen is placed.

17. Which of the following organisms belong to the kingdom Monera?
A-Amoeba
B- Protozoa
C- Yeast
D- Bacteria.

18. The diagram below shows a process that occurs in the duodenum

Name process Y
A-Assimilation
B-Hydrolysis
C-Emulsification
D-Peristalsis

19. While performing a class experiment, a student observed that the eye piece lens showed total darkness. Which one of the following parts of the microscope should not be adjusted by the student.
A-Fine adjustment knob
B-Diaphragm
C-Mirror
D-Objective lens

20. Which one of the following factors determine energy requirements in humans
A-Sex
B-Height
C-Weight
D-Race

21. What causes food to move down the oesophagus?
A-Wave-like contraction of stomach muscles
B-Boluses of food in the oesophagus pull each other
C-Contraction and relaxation of the muscles of the oesophagus
D-The force of gravity moves food down the oesophagus

22. Which one of the following is not a role of active transport.
A-Reabsorption of glucose from kidney tubules to blood stream
B-Absorption of glucose from alimentary canal to the blood stream
C-Excretion of waste products from the body cells
D- Reabsorption of water from the kidney tubules.

23. The diagram below shows a specialized cell.

How is the above cell adapted for its function?
A-The cell is thick to absorb water
B- The cell is elongated to conduct water
C- The cell has extensions to increase its surface area to absorb water and mineral salts
D-The cell has abundant cytoplasm

24. State the form in which carbohydrates are stored in animals
A- Starch
B- Proteins
C- Cellulose
D- Glycogen.

25. Which of the following statements best explains the term “ species?”
A- A group of organisms with hereditary distinction.
B- A group of organisms that cannot naturally interbreed
C- A group of organisms that are reproductively isolated
D- A group of organism that interbreed to produce viable offsprings

APPENDIX C: Student Motivation Questionnaire (SMQ)

The purpose of this Questionnaire is to find out your motivation to participate in a Biology class. You are assured that the information gathered from this study will be handled with confidentiality. You have the option to withdraw from the study.

a)Instructions

1) This is not a test and there are no RIGHT and WRONG ANSWERS

2) It is important that you give your HONEST opinion

3) Read the items carefully and try to understand before making a choice that reflects your opinion

4) Circle around the letter that corresponds with your opinion. The letter choices are **SA**= Strongly Agree, **A**= Agree, **U**=Undecided, **D**= Disagree, **SD**= Strongly Disagree.

Draw a circle around

1. if you strongly disagree with the statement
2. if you disagree with the statement
3. if you are undecided on the statement
4. if you agree with the statement
5. If you strongly agree with the statement

b) School……………………Class………… Sign……………………

A. Self efficacy	**SD**	**D**	**U**	**A**	**SA**
1.Whether the Biology content is difficult or easy, I am sure I can understand it	1	2	3	4	5
2. I am confident about understanding difficult Biology concepts	1	2	3	4	5
3. I am sure I can do well on Biology tests.	1	2	3	4	5
4. If I put much effort I can learn Biology	1	2	3	4	5
5. When Biology activities are too difficult I don't give up	1	2	3	4	5
6. During Biology activities, I prefer to ask for the answer rather than think for myself.	1	2	3	4	5
7. When I find Biology content difficult, I try to learn it.	1	2	3	4	5

B. Active learning strategies	SD	D	U	A	SA
8.When learning new Biology concepts, I try to understand them	1	2	3	4	5
9.When learning new Biology concepts I link them to my previous experiences	1	2	3	4	5
10.When I do not understand a Biology concept I find relevant resources that will help me	1	2	3	4	5
11.When I do not understand a Biology concept, I would discuss with the teacher or other students to clarify my understanding	1	2	3	4	5
12. During the learning process, I try to make links between the concepts I learn.	1	2	3	4	5
13. When I make a mistake I try to learn it.	1	2	3	4	5
14. When I meet Biology concepts that I do not understand, I still try to learn them.	1	2	3	4	5
15. When new Biology concepts that I have learnt conflict with previous understanding, I try to understand why	1	2	3	4	5
C. Biology learning value	**SD**	**D**	**U**	**A**	**SA**
16. I think learning Biology is important because I can use it in my daily life	1	2	3	4	5
17. I think that learning Biology is important because it stimulates my thinking	1	2	3	4	5
18. In Biology I think it is important to learn to solve problems	1	2	3	4	5
19. I think is important to participate in Biology inquiry activities	1	2	3	4	5
20. It is important to have the chance to satisfy my own curiosity when learning Biology .	1	2	3	4	5

D. Performance Goal	SD	D	U	A	SA
21.I participate in Biology lessons to get a good grade	1	2	3	4	5
22. I take part in Biology lessons to perform better than other students	1	2	3	4	5
23.I take part in Biology lessons so that other students think I am smart	1	2	3	4	5
24. I take part in Biology lessons so that the teacher pays attention to me	1	2	3	4	5
D. Achievement Goal	**SD**	**D**	**U**	**A**	**SA**
25. During Biology lessons I feel most fulfilled when I get a good score in a test.	1	2	3	4	5
26. I feel most fulfilled when I feel confident about the content in a Biology lesson.	1	2	3	4	5
27. During a Biology lesson I feel satisfied when I am able to solve a difficult problem	1	2	3	4	5
28. During a Biology lesson I feel most satisfied when the teacher accepts my ideas.	1	2	3	4	5
29. During a Biology lesson, I feel most satisfied when other students accept my ideas.	1	2	3	4	5
F. Learning Environment Stimulation	**SD**	**D**	**U**	**A**	**SA**
30. I am willing to take part in Biology lessons because the content is exciting and changeable	1	2	3	4	5
31. I am willing to take part in Biology lessons because the teacher uses a variety of teaching methods	1	2	3	4	5
32. I am willing to take part in Biology lessons because the teacher does not put a lot of pressure on me	1	2	3	4	5
33. I am willing to take part in Biology lessons because the teacher pays attention to me.	1	2	3	4	5
34. I am willing to take part in Biology lessons because it is challenging	1	2	3	4	5
35. I am willing to take part in Biology lessons because the students are involved in discussions	1	2	3	4	5

APPENDIX D: Student Attitude Questionnaire (SAQ)

The purpose of this questionnaire is to find out how you feel about Biology as a subject. The participants in this study are urged to do so voluntarily and the information got will be handled with confidentiality.

a)Instructions

1) This is not a test and there are no Right and Wrong answers.

2) Read the items carefully and try to understand before choosing what truly reflects your honest opinion. It is important that you give your honest feeling.

3) Circle around the letter that corresponds with how you really feel about Biology

4) The letter choices are **SA**= Strongly Agree, **A**= Agree, **U**= Undecided, **D**= Disagree, **SD** = Strongly Disagree.

b) School………………………Class………….. Sign………………………

Attitude Items	SA	A	U	D	SD
1.I like Biology more than other subjects					
2. Biology and nature are strange for me					
3. I would like to have Biology lessons more often					
4. working with living organisms in Biology interests me					
5. Am not bored during Biology lessons					
6. I find biological processes very interesting					
7. I like Biology lessons					
8. My Biology teacher is my model					
9. My future career is dependent on Biology					
10. I would like to be a biologist					
11. I would like to make a career in Biology					

12. Biology is necessary for my future career					
13. Biology is important in understanding other subjects					
14. Biology is important compared with other subjects					
15. Biology helps me to develop skills of learning					
16. Everybody needs biological knowledge					
17. The progress of Biology improves the quality of lives					
18. Biology is useful for solving environmental problems					
19. Biology is an important part of my life					
20. My Biology teacher makes me do active work					
21. I like my Biology teacher					
22. My Biology teacher highly regards my ideas					
23. It is easy understanding what I learn in Biology					
24. Biology is one of the easiest subjects for me					
25. I like the way Biology is taught in our class					
26. I make much effort to understand Biology					
27. I use Biology equipment during lessons					
28. I use Biology models during lessons					
29. I use live animals during Biology lessons					
30. Only the teacher handles equipment during lessons					

APPENDIX E: Student Interview Guide (SIG)

1. How would you ensure that new learning relate what happens in school to what happens outside school?

2. Do you think biological explanations have changed with time? If yes, how have you come to know?

3. Should you question how and what you are being taught in a Biology classroom? If yes, how can you make sure this does not create hostility?

4. How can you help the teacher to plan what you are going to learn in Biology? Is this something you would prefer to do always?

5) Do you ask your fellow students to explain their ideas in the Biology class? If No explain why you don't do this?

6. What do you do when you encounter Biology concepts that are difficult to understand?

7. What would you do when new Biology concepts conflict with previous understanding?

8. Do you participate in Biology investigative activities? If No, explain why?

9. Do you participate in Biology lessons? If yes explain your drive to do so?

10. Explain what makes you most satisfied when learning Biology?

11. Describe what makes you more motivated to participate in Biology lessons?

12. Would you like to do Biology in the future? Why?

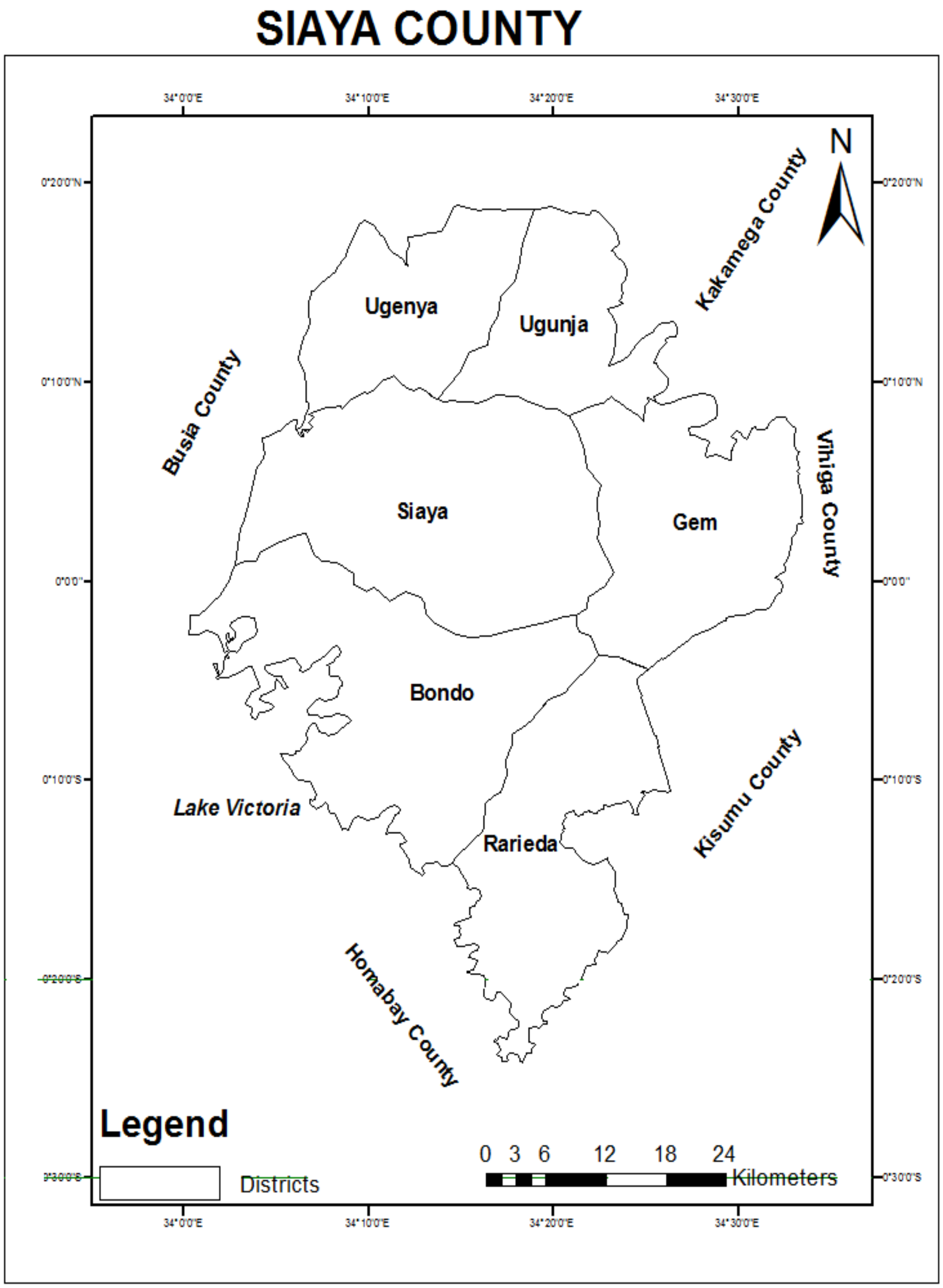
13. Do you like your Biology teacher? If No, Explain why?

14. Do you like Biology lessons? If yes, explain why?

15. Do you think Biology is important? Give reasons for your answer.

16. Which of the three sciences do you like most? Why?

APPENDIX F: Siaya County Map of the Study Area



APPENDIX G: Research Authorization

REPUBLIC OF KENYA

MINISTRY OF EDUCATION, SCIENCE & TECHNOLOGY

State Department of Education

Telephone:
Fax:

COUNTY DIRECTOR OF EDUCATION
SIAYA COUNTY
P.O. BOX 564
SIAYA

When replying please quote

Ref. SCA/10/VOL I (12)

4th December, 2013

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION FOR MR. ONGOWO R. OWINO – PG/PHD/0090/2011

The above mentioned has been mandated to carry out research in Siaya County vide an authorization letter from Maseno University Ref. PG/PHD/0090/2011 dated 12th August, 2013. The research title is "Constructivist Learning Environment: Perception and Correlates in High and Low Achieving Secondary Schools in Biology, Siaya County, Kenya".

Kindly accord him the necessary assistance.

COUNTY DIRECTOR OF EDUCATION
SIAYA COUNTY
04 DEC 2013
P.O. Box 190-40603 SIAYA

EZRA ODONDI
FOR COUNTY DIRECTOR OF EDUCATION
SIAYA COUNTY

Our Vision: To have a globally competitive quality education, training and research for Kenya's sustainable development